



OPERATION & MAINTENANCE MANUAL

GRANULAR CARBON ADSORPTION SYSTEM – (3) MODEL 10S

FOR

**AGVIQ, LLC
NASSAU COUNTY, NY**

**SOLD To: AGVIQ
VIRGINIA BEACH, VA**

***PREPARED BY
CALGON CARBON CORPORATION
PITTSBURGH, PA***

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SAFETY DEPENDS ON YOU

Calgon Carbon Corporation's equipment is designed and built with safety in mind. However, proper installation and operation can increase your overall safety.

DO NOT INSTALL, OPERATE OR REPAIR THIS EQUIPMENT WITHOUT READING THIS MANUAL AND THE SAFETY PRECAUTIONS CONTAINED THROUGHOUT.

BE SURE THAT ALL INSTALLATION, OPERATION, MAINTENANCE AND REPAIR PROCEDURES ARE PERFORMED ONLY BY QUALIFIED INDIVIDUALS.

QUESTIONS? Call Calgon Carbon Corporation at 1-800-422-7266

SAFETY HIGHLIGHTS

READ AND UNDERSTAND THE FOLLOWING SAFETY HIGHLIGHTS.

WARNING

This statement appears where the information must be followed exactly to avoid serious personal injury or loss of life

CAUTION

This statement appears where the information must be followed exactly to avoid minor personal injury or damage to equipment.

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SECTION 1

SYSTEM DESCRIPTION

SECTION 1

1.0 INTRODUCTION

This manual covers a general description and operating procedures for a Model 10 Single(s) Granular Carbon Adsorption System. This system is designed to treat liquid streams containing organic compounds amenable to adsorption using Calgon Carbon Corporation's granular activated carbon products. If the guidelines in this manual are read and followed carefully, the system can be operated efficiently and safely with minimal operating expense.

The recommended operating practices set forth in this manual are patterned to suit normal operating conditions. Different conditions may require modifications of these operating practices. Since varying operating conditions or problems may arise over long-term operation, the skill and judgment of the operating personnel should be exercised when needed.

This manual should be available to operating personnel and engineers so that the operating instructions are followed. Record all operating data and maintenance work (overhauls, repairs, etc.) in an operator's logbook. Only trained personnel should operate the system and perform maintenance. If further information beyond what is contained in this manual is required, please contact the nearest Calgon Carbon Corporation regional sales office for assistance.

Specific information concerning any custom design details for your installation is described in Section 1.1 (Model 10S Specifications and Operating Conditions).

1.1 MODEL 10S SPECIFICATIONS AND OPERATING CONDITIONS

1. Adsorber Vessel Specifications

Number of Vessels: Three (3)

Material of Construction: Carbon Steel

Tank Lining: Plasite 4110

Type of Heads:

Top: ASME 2:1 Elliptical

Bottom: ASME 2:1 Elliptical

Diameter: 10 Ft.

Straight Side Height: 12 Ft.

Design Temperature (° F):

Normal: 100 Max: 140

Design

Pressure: 125 psig @140° F

Paint: Primer / Finish: Sherwin Williams Macropoxy 646 / Acrolon 218

Vessel Capacities

Bed Volume: 5340 Gal.

Maximum Flow Rate: 700 gpm

Vessel Volume: 9020 Gal.

For system pressure drop see Section 7

Backwashing Information:

Bed Expansion 25%

For backwash rate refer to the bed expansion curve in Section 7.

1.1 MODEL 10S SPECIFICATIONS AND OPERATING CONDITIONS

2. System Weights and Dimensions (Approximate):

Empty Vessel Shipping Weight: 16,500 Lbs. (Each)

Operating Weight (Full with Liquid + Carbon): 102,000 Lbs. (Each)

Overall Length: 35'-0" Overall Width: 15'-0" Overall Height: 22'-6 3/4"

3. Vessel Accessories/Piping

Piping:

Carbon Transfer Piping: 4" Sch. 40 Stainless Steel (fill)
4" Stainless Steel (Discharge)

VESSEL NOZZLES	NUMBER	SIZE	FLANGE TYPE
Side Manway	1	20"	F.F.
Process In	1	8"	150# F.F.
Process Out	2	8"	150# F.F.
Carbon In	1	4"	150# LapJt
Carbon Out	1	4"	150# LapJt
Sample Taps	4	2"	125# F.F.
Btm. Manway	1	14"x18	F.F.

1.1 MODEL 10S SPECIFICATIONS AND OPERATING CONDITIONS

3. Vessel Accessories/Piping

Pressure Relief:

Graphite Rupture Disk

4. Carbon

Carbon Type:	Filtrisorb 300AR
Mesh Size:	8 x 30
Initial Fill:	20,000 Lbs.
Quantity per vessel:	20,000 Lbs.

5. Other Options:

Backwash Control Valve
Backwash Flow Meter
Individual Influent Flow Meter
In-Bed Sample Inserts (Three per Adsorber)
Individual Air/Vacuum Release Valves

1.1 MODEL 10S SPECIFICATIONS AND OPERATING CONDITIONS

6. Carbon Delivery

	DUMP TRUCK (*) (ATMOSPHERIC)	STANDARD TRAILER (15 PSIG HOPPER)	LIFT TRAILER (35 PSIG HOPPER)	TRIPLE COMPARTMENT TRAILER
Carbon (Lbs):	20,000	10,000	20,000	20,000
Utility Requirements:				
Air (SCFM):	--	100	100	100
(PSIG):	--	100 (**)	100 (***)	100 (**)
Water (GPM):	200-250	100	100	100
(PSIG):	80-120	--	--	--
Water Required to Fill				Compartment
Trailer (Gallons):	--	5,000	4,200	End Center
Dry Carbon:	--	4,200	3,500	2,800 5,000
Pre-Wetted Carbon:				2,500 4,200
Height Clearance (Ft):	--	13	26	14
Empty Weight (Lbs):	33,000	32,000	33,000	37,000
Filled Weight (Lbs):				
Dry Carbon:	73,000	52,000	53,000	57,000
Wet Carbon				
(Before Drain):	--	94,000	95,000	99,000
(After Drain):	--	72,000	73,000	77,000

(*) Unloading accomplished with eductor

(**) Regulated down to 15 psig max.

(***) Regulated down to 30 psig max.

1.2 GENERAL SYSTEM DESCRIPTION

This Model 10 Adsorption System is a unit consisting of three (3) Model 10 Single vertical pressure vessel, containing 20,000 pounds of granular activated carbon each. The vessels are configured to operate in parallel. Each vessel is complete with underdrain and carbon transfer piping. After connecting the influent and effluent piping to the systems, the vessels are ready to be placed into service. The initial fill of Granular Activated Carbon is shipped to the site for unloading directly as a water slurry.

The stream to be treated is pumped to the adsorption system at a flow rate compatible with the design capacity of the unit. The adsorption system is operated in a downflow mode through the granular carbon bed. Multiple Single Model 10 units will be operated in parallel flow to accommodate your entire stream.

Initially, the impurities are adsorbed onto the carbon in the upper portion of the carbon bed. As this top layer of carbon becomes saturated, adsorption takes place lower in the bed. Eventually all the carbon in the adsorber becomes saturated and the contaminant concentration of the effluent from the adsorber increases until it approaches or equals the influent concentration.

When the carbon in the vessel is exhausted, an empty trailer is sent to the site to remove the load of spent carbon. Pending completion of carbon acceptance by Calgon Carbon, the carbon will be returned to one of our plant sites for thermal reactivation.

The spent carbon is transferred from the adsorber to the bulk trailer by first filling the adsorber with water. The adsorber is then pressurized using compressed air as the motive force to facilitate the carbon transfer to the trailer.

Once the spent carbon transfer operation is completed, a charge of fresh carbon can be transferred into the empty adsorber. This is accomplished by filling the bulk trailer with water and placing a water cushion in the adsorber. The bulk trailer is then pressurized with compressed air to facilitate the carbon transfer into the adsorber.

In normal operation, the influent flow is directed to the vessel through the inlet line. When contaminant breakthrough is detected at the effluent of the vessel, the system is shut down for carbon replacement.

Pressure gauges should be installed on the influent and effluent lines to measure the pressure drop across the carbon bed. Pressure drop through an adsorber carbon bed is a function of many factors:

1. Pressure drop through the carbon bed(s).
2. Nozzle and piping pressure drop.
3. Flow rate, viscosity, and density of the liquid.
4. Solids build-up on top of the bed.
5. Bacteria growth or chemical precipitation in the bed.
6. Gas build-up in the bed.

Backwashing/backflushing is usually required when the pressure drop across an adsorber increases by 5 to 10 psi during the adsorption cycle.

Model 10S units come equipped with a 45° internal cone. This internal cone offers many advantages, such as ease of carbon removal and good flow distribution through the nozzle underdrain. Since the internal cone is not part of the exterior vessel, it is designed to withstand a working differential pressure of 20 psi. Note that this differential pressure is less than the maximum allowable working pressure (MAWP) for the vessel. High cone pressure differential could exist due to:

1. Unlimited backwash water flows. This is probably the most dangerous situation since the cone is weaker in the upflow direction.
2. Nozzle pluggage due to precipitation, fines or bacteria. This could happen either in the backwash or process operation.
3. Unlimited process flow.

Due to this differential pressure limitation across the cone, Calgon Carbon recommends that the client install pressure differential switches sensing pressure across adsorber vessels. The DP switch should be electrically interlocked shut down the feed pump if a high pressure differential develops across the cone. Note that the actual collapse of the cone is a remote possibility.



Do not operate the system unless the differential pressure switch on the vessel is operating properly. Otherwise, a high differential pressure that could cause damage to the internal cone may go undetected.

To prevent damage to the system in the event that the pressure limitation of the vessel is exceeded, a rupture disk is provided in the adsorber backwash outlet of each vessel. The rupture disk is sized to relieve at the design pressure of the vessel.

After start-up, records should be kept of pertinent data such as flow rate, pressure drop across each bed, total dissolved solids, temperature, pH, toxicity, and organic contaminant levels.



SECTION 2

INSTALLATION

SECTION 2

2.0 INSTALLATION

In addition to the instructions below, refer to the Shipping Specification included with this manual for instruction on shipping and handling of large adsorber systems.

2.1 FOUNDATIONS

The equipment can be set on a permanent or temporary foundation. A temporary foundation could be a steel skid or plate, paved area or concrete foundation to which the adsorber vessels can be secured. Any foundation, either temporary or permanent, must be adequate to support the operating weight of the unit. See the Calgon Carbon Corporation general arrangement drawing for the dimensions and weights of the system.

Before installation of a permanent system, the adsorber vessels should be oriented on the foundation to ensure that the inlet and outlet opening and anchor lugs are positioned properly. Anchoring can be installed either in the foundation or at time of vessel installation, provided local codes or regulations are satisfied. The outline of the adsorbers should be marked on the foundation.

2.2 EQUIPMENT INSTALLATION

A crane is required to off-load the vessels and piping skid(s). Lifting lugs are provided on all the vessels. A properly trained and experienced rigging crew should be employed to set the equipment. The vessels should be set on the foundation in a level position and be anchored as required by local codes and seismic regulations. Each vessel must be individually set.

1. The following instructions are typical for large modular adsorber systems. Refer to the project drawings for specific details; i.e. dimensions, weights and pipe sizes.
2. Before the equipment is shipped, a site visit is recommended to review specific site conditions that may affect delivery or installation. Special note should be made for:
 - Overhead clearances – power lines, trees, plant piping
 - Access to site – fences, trees, locations within neighborhood or plant
 - Soil conditions – Can the delivery truck get close to the installation site?
 - Foundations – Properly cured? Correct size to accept new system?

3. Receive adsorption equipment in accordance with plant site requirements. One trucks will be used to ship the following equipment.

- (2) Adsorber Vessels; Refer to project specific drawings for exact vessel dimensions and weight.
- Prefabricated pipe spools.
- (1) Adsorber Vessel; Refer to project specific drawings for exact vessel dimensions and weight.
- (1) Crate of hardware; Containing bolts, gaskets, pipe supports and u-bolts, gages etc.

Refer to the project drawings and material list enclosed in the crate for a comprehensive account of components provided for the particular job being installed.

4. Off load the equipment from truck to the pre-prepared mounting location. Set equipment on properly formulated foundation ensuring weight loading, anchor bolt depth, smooth level surface and adequate dimension for equipment footprint. For recommended lifting procedures refer to the section titled **GENERAL HANDLING AND LIFTING INSTRUCTIONS**.

5. The following installation steps can be accomplished in utilizing a crane for one day. Refer to the installation drawing, Figure 1A and Figure 1B, for generalized details and the project drawings for more specific details.
 - Set one vessel in proper location on the foundation
 - Position valve rack at the estimated point of hook-up. Make sure that vessel and valve rack are set true and level to plan.
 - Align the effluent nozzle on the bottom head, the effluent pipe, and rubber expansion joint with the appropriate valve rack connection.
 - Bolt-up snug when alignment is satisfactory.
 - Align the influent piping to the designated valve rack connection and connect expansion joint piping with tank nozzle on the top of the vessel, and bolt-up snugly.
 - Attach all pipe bracket supports and u-bolts as provided.
 - When it is determined that complete line up is acceptable finish bolting both effluent and influent lines.
 - Set the second vessel into position and line up second vessel with valve rack and effluent/influent piping as previously described.
 - When accomplished finish the bolt-up.
 - When completely satisfied with installation bolt vessels to foundation using predetermined anchor bolt hardware.
 - Connect (1) carbon fill, and (1) carbon discharge line to each vessel.
 - Install the vessel sample ports and connecting hardware as detailed on the project drawings.

- Mount pressure gauges and instruments as shown on project drawings.
 - Install the Carbon Acceptance Canister.
 - If equipment is supplied with an electrical panel, run power feed to the panel and make connections per the interconnection drawing.
6. The customer should connect from the connections on the pipe manifold; influent, effluent, backwash supply and backwash outlet, to the plant supply piping. Gaskets and bolts supplied by the customer. Client supplied effluent piping for the adsorption system should include an anti-siphon loop or adequate backpressure to ensure that the water level in the vessels covers the media during operation.
- The pressure relief discharges to the backwash outlet/vent line. The backwash outlet/vent line should have unrestricted flow to atmosphere.
7. Each vessel has underdrain nozzles pre-installed by CCC. For internal underdrains; ring type and internal cones, the septa should be checked for tightness before the manway covers are closed and secured.
8. The system is now ready for hydro testing and disinfection as required.

2.3 GENERAL HANDLING AND LIFTING INSTRUCTIONS

The recommended lift points are shown on the installation drawing; lifting lugs on vessel top head, vessel leg anchor base plates and location shown on the valve rack.

1. Always make lift attachments to the designated lift points when using chains or cables. Never lift using a vessel nozzle.
2. Operators of hoisting and moving equipment must follow proper rigging procedures at all times.
3. Always lift - **NEVER** roll or slide equipment.
4. When moving equipment, do not drop or allow hard impact. Do not allow cables, hooks, or spanner bars to swing against or slide over the vessel.
5. Never allow tools to strike or drop on equipment (especially inside or outside of vessels).
6. Never allow bare metal chains or cable to slide against the metal surface of equipment causing marring, deformation or serious defects in the metal.
7. Avoid temporarily bracing vessels or equipment with metal structures, wood is acceptable for this application. Avoid striking vessel with tools or instruments of any kind.
8. All ladders used inside vessels shall have ends protected. Ladders shall have rubber protectors to prevent damaging the lining.
9. Workmen entering a lined vessel must wear soft-soled shoes, free of grit. Workmen must follow plant and OSHA requirements for confined space entry.

2.4 RECOMMENDED UNLOADING AND PLACEMENT PROCEDURES

(Refer to Shipping Specification VS13)

1. Vessel and miscellaneous equipment unloading shall be accomplished in such a manner as to avoid damage to finished surfaces. Adequate padding may be necessary around the lifting point. Wooden chocks and crating should be carefully removed where necessary.
2. Utilize chains, nylon slings, or a spreader bar for hoisting vessels. The angle between the lifting point and the top of the equipment must always be 60° or greater. Workmen shall keep control over the vessel with guidelines. No metal rigging may come in contact with the vessel except for specifically designed lift points or lifting lugs.
3. A crane is required to off-load, move and hoist into position the vessels and piping assemblies. Lift points are provided on all pieces. A properly trained and experienced rigging crew shall be employed to set the equipment. The equipment shall be set on a solid foundation, made level as possible and anchored as required by local codes and seismic regulations. Each vessel must be individually set.
4. Piping connection points to vessels and valve rack shall be free of mechanical stress. Do not force pipe connections to these points for damage can result.
5. Follow safe anchor bolt installation practices.
6. Dirt marks shall be cleaned from the surface of all Equipment upon completion of the installation. Marred paint resulting on Vessels and all equipment pieces shall be touched up with a paint of comparable color and quality. More severe damage requires appropriate surface cleaning and preparation before primer and finishing paint are applied.

FIGURE 1A FRONT VIEW OF TYPICAL INSTALLATION DIAGRAM

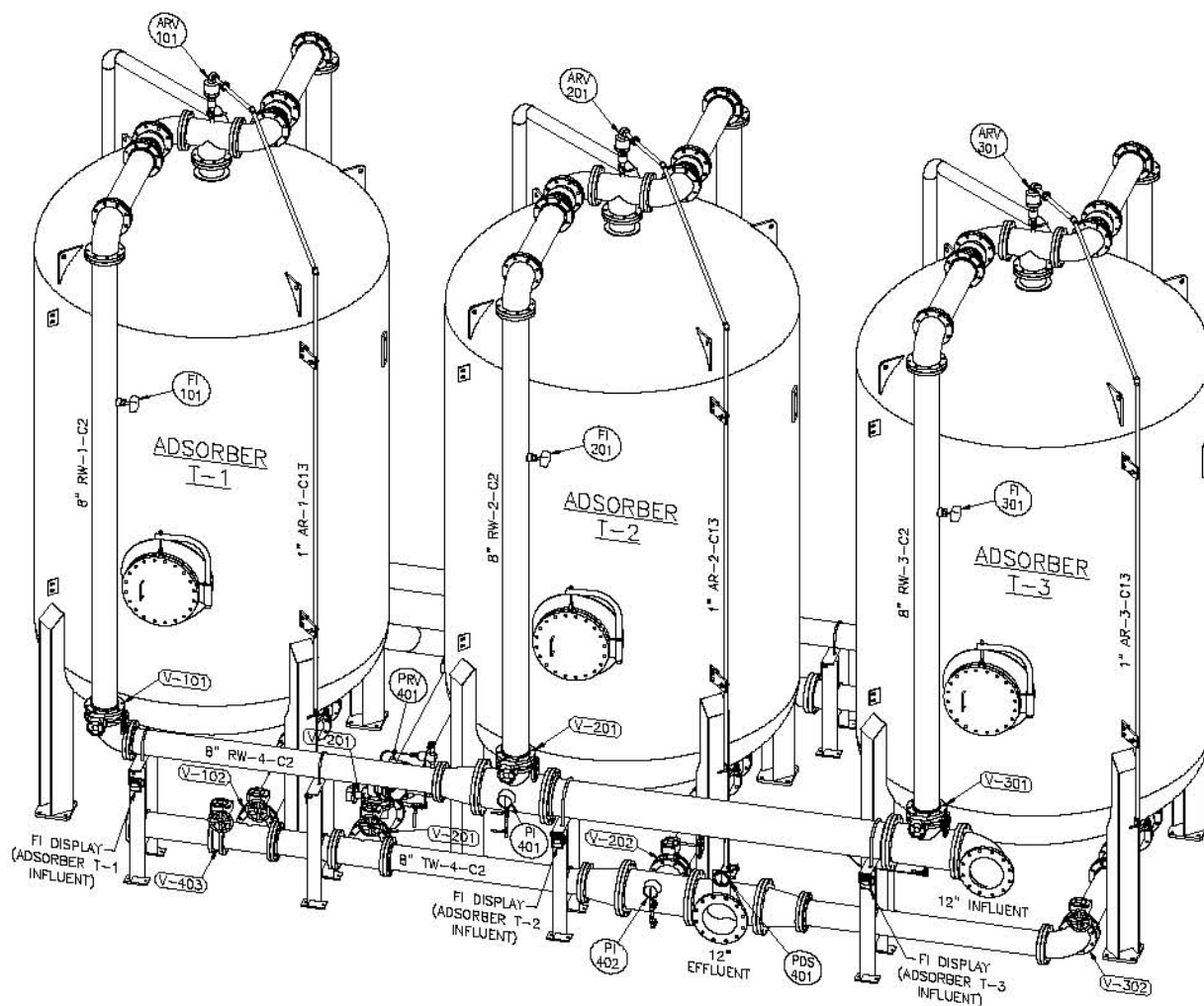
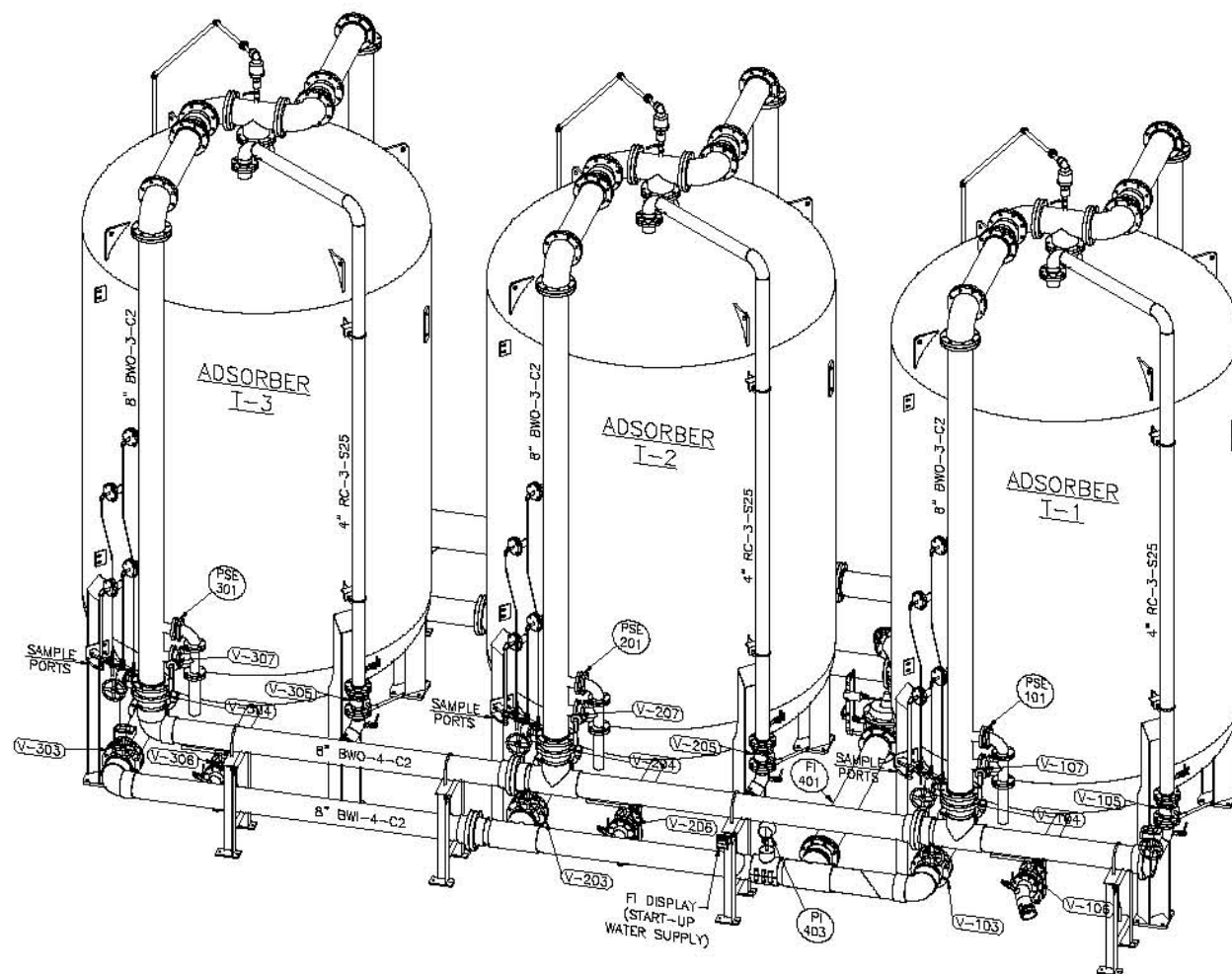


FIGURE 1B BACK VIEW OF TYPICAL INSTALLATION DIAGRAM





SECTION 3

OPERATION

SECTION 3

3.0 OPERATION

3.1 PRE-OPERATION CHECK-OUT

All equipment and systems affiliated with the granular carbon adsorption system such as pumps, filters, etc. should be checked out according to the manufacturer's instructions. Specific activities to complete before operating the adsorption equipment should include the following:

1. Check all piping connections for proper installation and tightness.
2. Ensure that all gauges and instruments are functional and installed correctly. Re-zero or re-calibrate if necessary.
3. Close all valves in the adsorber piping system.
4. Install the carbon acceptance canister after checking to ensure it is filled with carbon.

For potable water treatment installations, the client will be responsible for cleaning and disinfecting the vessels and piping prior to filling the system with carbon. The procedures to complete this step in the installation process are the responsibility of the client.

3.2 FILLING AN ADSORBER WITH CARBON

After the system has been checked, the adsorber is ready to be filled with granular activated carbon. The carbon is transferred to the adsorber as a water slurry from Calgon Carbon trailers. The detailed procedures for making the transfer are given in Section 4.3.

The trailer driver connects the necessary hoses and operates all the valves on the trailer. A plant operator should be available to operate the valves on the adsorber vessel.

After all the carbon is transferred from the trailer, the driver disconnects the hoses and closes the valves on the trailer. The plant operator closes the valves in the vent and carbon fill lines on the adsorber. The adsorber is now ready to be backwashed or backflushed.

3.3 WETTING (DEAERATING THE CARBON)

In a typical bed of virgin carbon, the pore volume is approximately 40% of the bed volume. Carbon which is shipped dry will contain air in these pores. Therefore, the carbon must be properly wetted prior to being placed on stream. If this is not done, the air within these pores will displace into the void spaces between the carbon particles during operation and cause high pressure drop and channelling in the adsorbers. These problems can cause premature breakthrough of contaminants. Air will not migrate out of the bed during normal downflow operation.

The time required for wetting is a function of liquid temperature and viscosity. Generally, a minimum wetting period of 24 hours is required using water at ambient temperatures, although a period of up to 72 hours is preferred for complete wetting. After wetting, backwashable adsorbers should be backwashed to remove air and segregate the carbon by size.

As an alternative, the Calgon Carbon Service trailer containing fresh carbon may be filled with water and allowed to stand for several hours. When the fresh carbon is transferred to the adsorber, the adsorber should be backwashed to eliminate any remaining air.

In applications where limited amounts of backwash water is available, after the carbon has been wetted, the adsorber should be drained and then backfilled until water flows out the vent line. The adsorber should be filled up-flow at 4 gpm/ft², maximum. For a Model 10S System this is 300 gpm, maximum.

If the unit must be placed on-stream before the carbon has been wetted, the adsorbers should be drained and backfilled when the pressure drop becomes prohibitive or after two days of operation, whichever occurs first.

3.4 BACKWASHING AND BACKFLUSHING

3.4.1 BACKWASH/BACKFLUSH -- GENERAL

Backwashing and backflushing are procedures involving running clean, contaminant-free water upflow through the adsorber. Backwashing or backflushing of a carbon bed can be done after fresh carbon has been transferred into an adsorber and wetted, or during operation to remove sediment from the top of the bed.

If the adsorber is to be backwashed during operation, it should be backwashed prior to startup. The reasons for backwashing before placing fresh carbon on-line are to: (1) size segregate the carbon so subsequent backwashing will return the carbon to the same relative position in the bed, (2) remove any remaining air from the bed, and (3) remove carbon fines which can, in some cases, lead to excessive pressure drop and flow restriction.

Backwashing is done during operation to remove: (1) sediment from the top of the bed, (2) carbon fines that may be plugging the underdrain nozzles, and (3) air that is binding the bed. The need to backwash is indicated by an increased bed pressure drop.

Backwashing an adsorber results in expanding the carbon bed, removing air, suspended solids and carbon fines and classifying the carbon particles. The backwash flow rate depends upon the carbon particle mesh size and the water temperature (refer to the bed expansion curve in Section 7). Generally, rates in the range of 10 to 15 gpm/ft² (800-1200 gpm) are sufficient to remove solids, remove air, and expand the bed. However, backwashable Model 10S units are designed with significant straight side height to permit 25% bed expansion, and the selected backwash rate should limit the bed expansion to a maximum of 25%. For your system, Use the bed expansion curve in Section 7 to determine a backwash rate if the water source is at a different temperature.

In a system that is not designed for backwashing, an operation termed backflushing can be used to remove fines from the upper portion of the bed. This operation will not remove fines from the lower portion of the bed because it does not expand the bed. Expansion of the bed allows the fines at the bottom of the bed to move to the top. However, fines do not always cause high pressure drop, and their removal is not always necessary.

The backflushing rate is 2 to 3 gpm/ft² and this is not significant enough to expand the carbon bed. For the Model 10S adsorber this is a flow rate from 150 gpm to 225 gpm. Flow rates of less than 300 gpm will not expand the bed; therefore, size segregation of the bed will not occur. The time required for backflushing is 30 to 45 minutes.

Normally when backwashing or backflushing, a clean external water source is used. The stream should be compatible with the system and free of suspended solids and organic contaminants which might affect adsorption. If necessary, effluent from the adsorber system may be used as the water source. In this case a tank with storage capacity for 15 minutes of backwash water (18,000 gallons) will be necessary.

When normal downflow operation is started after backwashing, the initial 5 to 15 minutes of effluent flow will be dark due to a small quantity of fines. Under normal operating conditions, this condition will clear up.

3.4.2 BACKWASHING AN ADSORBER

In this mode, the effluent header is used as the source for the backwash water. The vessel being backwashed needs to be isolated prior to backwashing. Flow should be increased slowly to design backwash flow rate and valves should be operated carefully to avoid water hammer.

Sequence	Vessel ID		
	T-1	T-2	T-3
Close Influent Valve	V-101	V-201	V-301
Close Effluent Valve	V-102	V-202	V-302
Open Backwash Outlet	V-404	V-404	V-404
Open Backwash Outlet	V-104	V-204	V-304
Open Backwash Inlet	V-103	V-203	V-303
Open Backwash Supply	V-401	V-401	V-401

The backwash water enters the vessel through the effluent nozzle and flows up through the underdrain and the carbon bed. The backwash water discharge from the influent nozzle should be observed for clarity to determine the duration of backwashing. Backwashing for high pressure drop should take approximately 10 minutes. If excessive sediment and turbidity exists in the untreated water, the backwashing times may have to be increased to 15 minutes. A fresh carbon fill

should be backwashed to classify the carbon. The time required for this step is approximately 30 minutes or until the backwash discharge is free of fines.

3.4.3 Re-Starting System After Backwashing

1. End backwashing:

Sequence	Vessel ID		
	T-1	T-2	T-3
Close Backwash Supply	V-401	V-401	V-401
Close Backwash Inlet	V-103	V-203	V-303
Close Backwash Outlet	V-104	V-204	V-304
Close Backwash Outlet	V-404	V-404	V-404
Open Effluent Valve	V-102	V-202	V-302
Open Influent Valve	V-101	V-201	V-301

2. Start-up down flow

3.5 START-UP

3.5.1 PARALLEL FLOW

The following sequence of steps should be followed to bring an adsorption system on-line in the parallel mode:

1. Check that all the valves in the adsorption system are closed.
2. Open the valves in the effluent lines from the adsorbers (V-102, V-202, V302).
3. Start the feed pump and open the valve in the pump discharge line.
4. Slowly open the valve in the influent line to one adsorber (either V-101, V-201, or V-301) and allow the pressure to increase to the operating level.
5. Slowly open the valve in the influent line to the other adsorbers (either V-101, V-201, or V-301) and allow the pressure to increase to the operating level.
6. Open the 3/4" valve located on the side wall of each vessel to bleed off any air that is trapped underneath the internal cone.

At this point, flow should be established downflow through both vessels and they will be on-line in parallel.

Set the flow rate to the system at the desired value after flow is established to the unit. The flow control meters and control instrumentation will be provided by the client as required for the system.

In order to obtain full utilization of the carbon and prevent air entrapment and channeling in the bed, the water level must remain above the carbon bed. To prevent the bed from draining due to gravity or loss of influent supply, a vacuum break (anti-siphon) loop or backpressure should be included by the client in the effluent piping. This start-up sequence assumes that an anti-siphon loop is present in the effluent piping. If no anti-siphon loop or backpressure is present, start the system by starting the pump and opening the valves in the opposite order of the sequence given previously (i.e., open the influent valves first, followed by the effluent valves).

For parallel operation, flow is established to each vessel by opening the valves as indicated previously. Changing the flow to one vessel may result in a flow change to the other vessel on the skid. This occurs because the vessels share a common influent and effluent line. Flow meters can be installed in the individual influent lines to each vessel to balance the flow to each unit if required.

After the system is operating at steady state, water flow to the Carbon Acceptance Canister (CAC) can be started. The GAC in the canister must first be wetted, refer to Section 3.3 for wetting instructions and Section 7 for information on the carbon acceptance canister.

3.6 Steady State Operation

Once flow is established to the vessels and the flow rate is set, no further adjustments are made during normal operation. The operator should establish a routine to check the adsorbers and to collect operating data. This data can be used to establish a maintenance schedule, to determine when backwashing/backflushing is necessary, or to determine when fresh carbon is needed.

3.6.1 Monitoring

Sample connections are provided on the influent and effluent lines from each vessel to take periodic samples for analysis as well as on the sides of each vessel.

Pressure gauges are provided to determine the pressure drop across each carbon bed. Taking periodic pressure readings will provide the operator with historic data for troubleshooting purposes. In the event that operating conditions change, the operator has the capability of taking corrective action.

3.6.2 Valve Operation

All valves should be operated in a slow and even motion. Abrupt opening and closing of the valves can shock the system. Since complete shut-off of flow while a pump is operating could cause damage to the pump, the valves should be operated in the proper sequence in order to always maintain flow through the system. If the vessels are identified as T-1, T-2 and T-3 then the corresponding valve positions during adsorption are given as follows:

The sequence of valve opening should start with the downstream valve and proceed toward the supply.

Process Valve Number	T-1 Single Bed Operation			T-2 Single Bed Operation			T-3 Single Bed Operation		
		Backwash T2	Backwash T3		Backwash T1	Backwash T3		Backwash T1	Backwash T2
V-101	Open	Open	Open	Closed	Closed	Closed	Closed	Closed	Closed
V-102	Open	Open	Open	Closed	Closed	Closed	Closed	Closed	Closed
V-103	Closed	Closed	Closed	Closed	Open	Closed	Closed	Open	Closed
V-104	Closed	Closed	Closed	Closed	Open	Closed	Closed	Open	Closed
V-105	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed
V-106	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed
V-107	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed
V-201	Closed	Closed	Closed	Open	Open	Open	Closed	Closed	Closed
V-202	Closed	Closed	Closed	Open	Open	Open	Closed	Closed	Closed
V-203	Closed	Open	Closed	Closed	Closed	Closed	Closed	Closed	Open
V-204	Closed	Open	Closed	Closed	Closed	Closed	Closed	Closed	Open
V-205	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed
V-206	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed
V-207	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed
V-301	Closed	Closed	Closed	Closed	Closed	Closed	Open	Open	Open
V-302	Closed	Closed	Closed	Closed	Closed	Closed	Open	Open	Open
V-303	Closed	Closed	Open	Closed	Closed	Open	Closed	Closed	Closed
V-304	Closed	Closed	Open	Closed	Closed	Open	Closed	Closed	Closed
V-305	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed
V-306	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed
V-307	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed
V-401	Closed	Open	Open	Closed	Open	Open	Closed	Open	Open
V-402	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed
V-403	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed
V-404	Closed	Open	Open	Closed	Open	Open	Closed	Open	Open



Process Valve Number	Two Bed Operation T1 and T2		Two Bed Operation T1 and T3		Two Bed Operation T2 and T3		Three Bed Operation T1, T2 and T3
		Backwash T3		Backwash T2		Backwash T1	
V-101	Open	Open	Open	Open	Closed	Closed	Open
V-102	Open	Open	Open	Open	Closed	Closed	Open
V-103	Closed	Closed	Closed	Closed	Closed	Open	Closed
V-104	Closed	Closed	Closed	Closed	Closed	Open	Closed
V-105	Closed	Closed	Closed	Closed	Closed	Closed	Closed
V-106	Closed	Closed	Closed	Closed	Closed	Closed	Closed
V-107	Closed	Closed	Closed	Closed	Closed	Closed	Closed
V-201	Open	Open	Closed	Closed	Open	Open	Open
V-202	Open	Open	Closed	Closed	Open	Open	Open
V-203	Closed	Closed	Closed	Open	Closed	Closed	Closed
V-204	Closed	Closed	Closed	Open	Closed	Closed	Closed
V-205	Closed	Closed	Closed	Closed	Closed	Closed	Closed
V-206	Closed	Closed	Closed	Closed	Closed	Closed	Closed
V-207	Closed	Closed	Closed	Closed	Closed	Closed	Closed
V-301	Closed	Closed	Open	Open	Open	Open	Open
V-302	Closed	Closed	Open	Open	Open	Open	Open
V-303	Closed	Open	Closed	Closed	Closed	Closed	Closed
V-304	Closed	Open	Closed	Closed	Closed	Closed	Closed
V-305	Closed	Closed	Closed	Closed	Closed	Closed	Closed
V-306	Closed	Closed	Closed	Closed	Closed	Closed	Closed
V-307	Closed	Closed	Closed	Closed	Closed	Closed	Closed
V-401	Closed	Open	Closed	Open	Closed	Open	Closed
V-402	Closed	Closed	Closed	Closed	Closed	Closed	Closed
V-403	Closed	Closed	Closed	Closed	Closed	Closed	Closed
V-404	Closed	Open	Closed	Open	Closed	Open	Closed

3.7 SHUTDOWN

3.7.1 SHORT TERM SHUTDOWN

For short duration shutdowns lasting less than one or two weeks, little needs to be done. Close all valves in the adsorber piping system, and open the vent line valves on the vessel. The feed pumps should be shut down and the valves closed in the lines to and from the pumps. Any drain valves in the pump casing should be opened for the duration of the shutdown. Freeze protection measures such as draining lines at the low points should be taken when there is a chance of freezing. Freeze protection measures are usually the responsibility of the client.

3.7.2 EXTENDED SHUTDOWNS

For extended shutdowns, in addition to the steps in Section 3.5.1, the adsorber should be drained of all water.

When the adsorbers are started up again, the carbon beds may require disinfection. If disinfection is required, the procedures to disinfect a carbon bed can be found in Section 7 of this manual. Once the disinfection is complete, backwashable adsorbers should be backwashed prior to start-up.

After disinfection, bring the adsorber back on-line in the downflow mode, monitor the effluent for coliform count and monitor the pressure drop.

3.8 TROUBLESHOOTING GUIDE

PROBLEM		PROBABLE CAUSE		REMEDY
High pressure drop across adsorber.	1.	Bed not flooded. Bed is air bound.	1.	Open vent valve or carbon inlet valve to release pressure. Add water upflow to fill vessel. Establish constant forward flow, then close valve.
	2.	High feed pump pressure.	2.	Throttle feed pump.
	3.	High suspended solids loading or carbon fines around the nozzles.	3.	Test feed for suspended solids. Install influent filter. Backwash/backflush the adsorber.
	4.	Improper valve settings.	4.	Check valve sequence.
Carbon in the effluent.	1.	Internal mechanical (i.e. underdrain) failure.	1.	Remove carbon and make repairs. In addition, inspect carbon retainer (if provided) in effluent line and replace if necessary.
Leaking flange.	1.	Loose bolts.	1.	Tighten bolts.

3.8 TROUBLESHOOTING GUIDE

PROBLEM		PROBABLE CAUSE		REMEDY
Sudden high contaminant concentration in effluent.	1.	Carbon heel from improper transfer.	1.	Wait until contaminant flushes out. Review transfer procedures.
	2.	Leaking valve.	2.	Repair/replace valve.
	3.	Mass transfer zone has extended into effluent.	3.	Replace carbon.

3.8 TROUBLESHOOTING GUIDE

PROBLEM		PROBABLE CAUSE		REMEDY
Premature breakthrough of organics in the effluent.	1.	Influent concentration change.	1.	Confirm by analyzing effluent sample(s) before changing carbon.
	2.	Air in the influent stream.	2.	Open vent valve and fill bed upflow with water as required.
	3.	Background TOC or colloids present.	3.	Change carbon.
	4.	Leaking valves.	4.	Check operation of valves in influent and effluent lines.
	5.	Incorrect valve sequence.	5.	Sequence the flow through the system properly.
Carbon heel in empty vessel.	1.	Insufficient rinse water.	1.	Provide additional rinse water flow.
	2.	Mechanical failure.	2.	Check vessel internal parts and make repairs.
	3.	Foreign material on the carbon.	3.	Rinse vessel to remove carbon.



SECTION 4

CARBON TRANSFER PROCEDURE

SECTION 4

4.0 CARBON TRANSFER PROCEDURE - STANDARD TRAILER

The procedures that are detailed in this section of the manual are for Calgon Carbon's standard carbon trailer.



Isolate the PVC backwash headers before transferring carbon to or from the Model 10 vessels. Carbon transfers use compressed air. It is unsafe to subject plastic piping to any air pressure. Insure the 8" valves on the backwash headers are closed before initiating a carbon transfer.

In cold weather conditions, steam may be used to thaw the trailer and transfer lines if necessary. Contact Calgon Carbon for trailer steaming procedures if required.

4.1 SITE REQUIREMENTS

A flat paved area is needed to support the Calgon Carbon service trailer which may weigh up to 100,000 pounds. The overhead clearance required for the adsorption system is 13 feet. A diagram of the trailer and its on-board piping is shown in Figure1.

The utility and piping requirements to connect to the adsorber and trailer are as follows:

Adsorber

Plant Air Line	3/4" female Kamlock connection 100 scfm at 30 psig min. (Attaches to 3/4" flush connection on carbon fill line above carbon inlet valve)
Plant Water Line	100 gpm (max) at 30 psig min. (Attach at drain connection supplied by others)

Trailer (See Figure 1)

Plant Air Line	3/4" female Kamlock connection (for both industrial & food grade trailer) 100 scfm regulated to 15 psig max.
Plant Water Line	4" Kamlock connection (female for industrial trailer, male for food grade trailer) 100 gpm regulated to 15 psig max. (Connect to Trailer Carbon Fill or Discharge Line)

4.2 SPENT CARBON TRANSFER TO TRAILER

Spent carbon transfer from the adsorber to the trailer is accomplished by pressurizing the adsorber with plant air. When the transfer is complete, the spent carbon in the trailer is drained of water. Prior to disconnecting any lines, the air supply must be shut off, and the adsorber and all transfer lines must be vented.

4.2.1 Spent Carbon Transfer

A. Prepare for Spent Carbon Transfer:

1. Close all adsorber valves.
2. Connect the adsorber carbon outlet line to the trailer carbon fill line using 4" flexible hose.
3. Open the center manway of the trailer or trailer vent valve for venting.

4. Open valve the trailer carbon fill line valve.
5. Check that the adsorber is full of water.
6. To aid the initial phase of transferring spent carbon, fill the transfer line with water. To do this, use a 3/4" water hose to fill the transfer line with water at the adsorber carbon outlet valve's flush-out connection.

B. Transfer Spent Carbon

1. Open the 3/4" air line valve slowly and pressurize the adsorber to 25 to 30 psig.
2. Open the 4" adsorber carbon outlet valve (V-106, V-206, V-306) and transfer the spent carbon to the trailer.
3. As the trailer starts to fill with carbon slurry, open the trailer septa valves to drain off excess motive water.

The transfer should take 20 to 30 minutes. The transfer will end with a loss of pressure in the adsorber and the sound of air in the transfer line.

A small heel of carbon may remain in the adsorber. This material will have to be removed. Close the carbon outlet valve on the adsorber and add plant water to the adsorber for 2-3 minutes (through the drain connection or backwash inlet). Leave the 3/4" air line open. When the adsorber pressure reaches 25 psig, open the adsorber carbon outlet valve (V-106, V-206, V-306) and transfer the remaining amount of carbon into the trailer.

C. End Transfer

1. Close the plant air line valve.
2. Vent the tank and lines through the trailer vent valve.
3. Open the adsorber vent valve (V-107, V-207, V-307) to further aid the venting.
4. Close the adsorber carbon outlet valve. (V-106, V-206, V-306)

5. Using a 3/4" water hose at the adsorber carbon discharge line flush-out connection, flush out the transfer line for a few minutes to remove all traces of carbon. Bleed the water hose and remove it.

4.2.2 Drain Water From Trailer

A. Prepare for Draining Water

1. Close all valves on the trailer. Close the trailer manway.
2. Connect the plant air line to the 3/4" connection on trailer carbon fill line using the air line hose.
3. Connect the trailer carbon discharge/drain line to the drain line in the trench by means of a 4" flexible hose.

B. Draining Trailer

1. Pressurize the trailer to 15 psig by slowly opening plant air line valve T4 on the trailer.
2. Open 2" trailer septa valves.

By pressurizing the trailer, water will be drained in less time than if drained by gravity.

C. End Draining

1. When the carbon is completely drained, close the air line valve on the trailer.
2. Vent trailer slowly through trailer vent valve.
3. When venting is complete, close all valves on the trailer and disconnect all hoses.

The trailer is now full of drained spent carbon and is ready for return to Calgon Carbon Corporation for reactivation.

4.3 FRESH CARBON TRANSFER FROM TRAILER

Fresh carbon is transferred in a slurry using plant air pressure. The trailer is first filled with water to create the slurry. The carbon slurry hose on the trailer is connected to the adsorber fill line and the trailer carbon discharge line. After putting a water cushion in the adsorber, the trailer is pressurized and the carbon slurry is transferred to the empty adsorber. Prior to disconnecting any lines, the air supply must be shut off, and the trailer and all transfer lines must be vented.

Under no circumstances should the standard and triple compartment trailers be connected to a pressure source exceeding 15 psig.

4.3.1 Fill The Trailer With Water

If the carbon is wetted prior to delivery, about 4000 gallons of water will be required. If the carbon is dry, about 5000 gallons of water will be required. The trailer may be filled either upflow or downflow.

A. Filling Operation

1. Connect water line to the trailer (carbon fill line if filling downflow, carbon discharge line if filling upflow) using a 4" flexible hose.
2. Open one top manway to vent trailer during filling.
3. Open trailer vent line valve.
4. Open trailer water line valve.
5. Open plant water line valve slowly and fill the trailer.

The trailer will be filled with approximately 4000 to 5000 gallons of water. The trailer filling shall be visually determined by observing the water level through the manway or by metering the desired amount.

B. End Filling Operation

1. Close plant water line valve.
2. Close trailer water line valve, manways, and trailer vent valve.
3. Disconnect hose.

4.3.2 Transfer Carbon To Adsorber

A. Prepare for Transfer

Place about 1000 gallons of water in the adsorber. This water cushion helps to protect the underdrain system and vessel lining.

1. Connect the adsorber fill line to the trailer carbon discharge/drain line using 4" flexible hose.
2. Connect the 3/4" plant air line to the trailer carbon fill line using the air line hose.
3. Close all valves on the adsorber.
4. Open the adsorber vent valve (supplied by others).
5. To aid the initial phase of transferring fresh carbon, fill the transfer line with water. To do this, use a 3/4" water hose to fill the transfer line with water, at the carbon inlet valve's flush-out connection.

B. Transfer Fresh Carbon

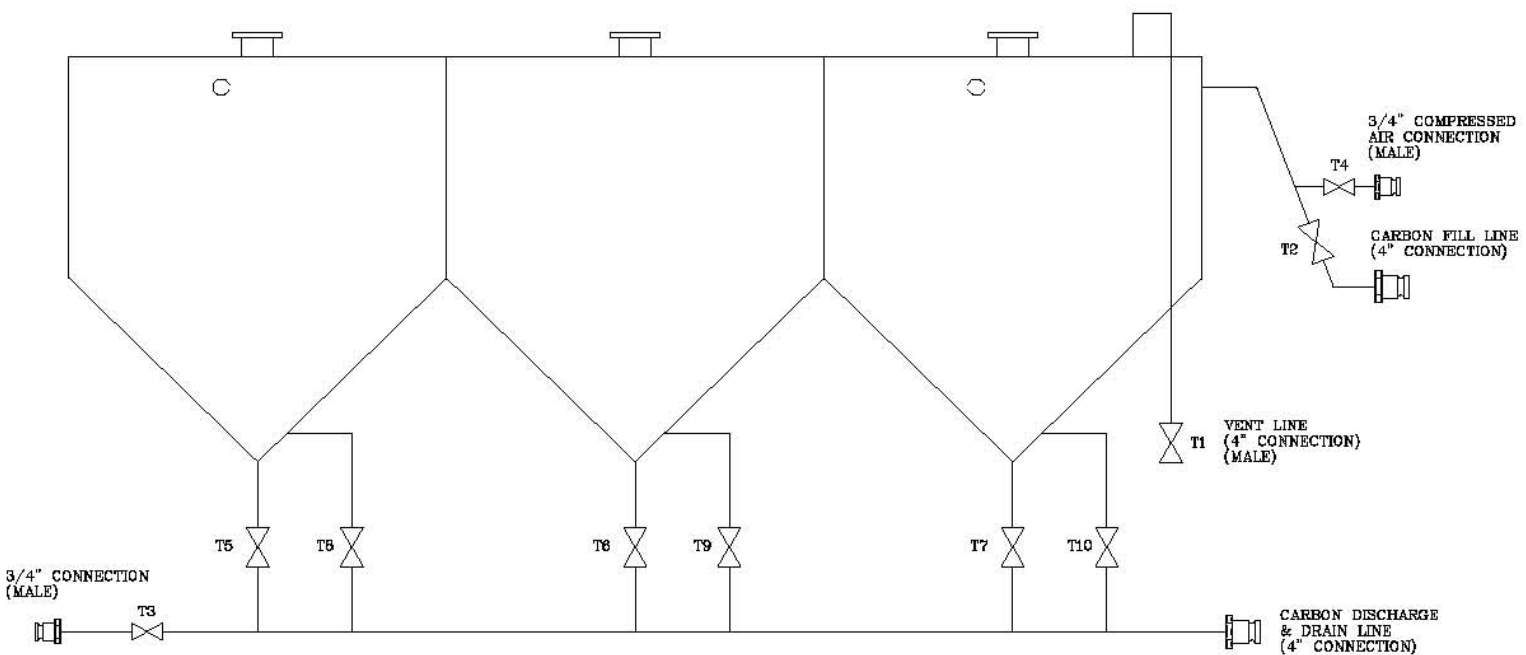
1. Pressurize the trailer to 15 psig by slowly opening the plant air line valve and then slowly opening valve in the trailer carbon fill line.
2. Open the adsorber fill line valve. (V-105, V-205, V-305)
3. The Calgon Carbon trailer driver will open the trailer carbon outlet valves to empty the respective hoppers.

4. If a water cushion is utilized, open an adsorber drain valve shortly after starting the transfer. This is done to reduce the amount of water that overflows at the end of the transfer. The disposal of the excess motive water is provided by the customer.

C. End Transfer

1. Close the plant air valve and vent the trailer through the adsorber vent valve.
2. Close the adsorber drain valve if it was utilized during the transfer.
3. Slowly open trailer vent valve for additional venting.
4. When completely vented, close the adsorber fill line valve (V-105, V-205, V-305), disconnect the hoses, and close the trailer valves.
5. Refer to Sections 3.3 and 3.4.2 for instructions on wetting and backwashing/backflushing the adsorber.
6. After the adsorber has been backwashed/backflushed, shut off the plant water and close the vent valve on the adsorber.

FIGURE 1 STANDARD TRAILER



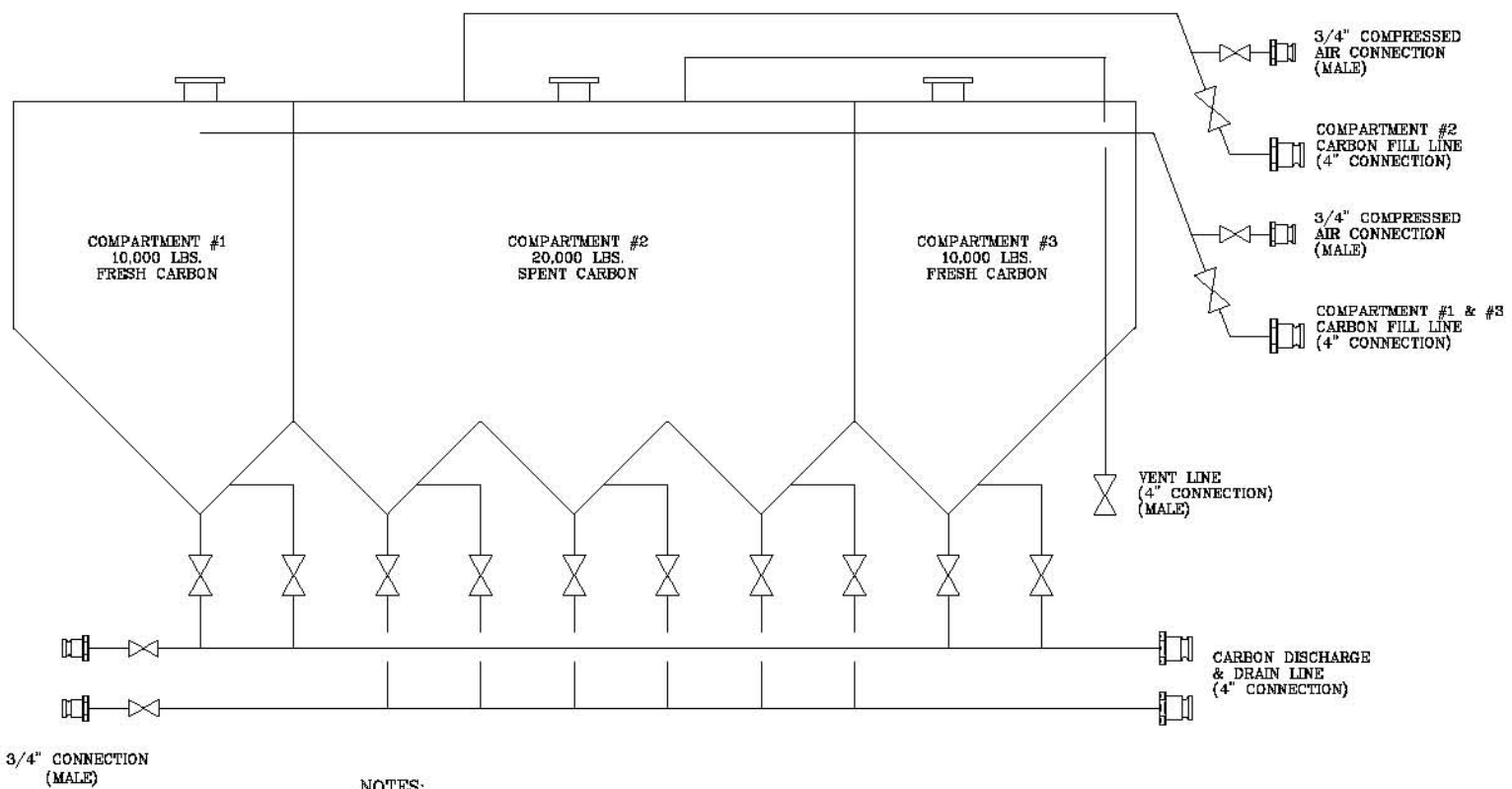
NOTES:

1. FOR INDUSTRIAL TRAILERS, THE CARBON FILL & DISCHARGE CONNECTIONS ARE KAMLOCK STYLE (MALE).
2. FOR FOOD GRADE TRAILERS, THE CARBON FILL & DISCHARGE CONNECTIONS ARE KAMLOCK STYLE (FEMALE).
3. ALL OTHER CONNECTIONS ARE MALE KAMLOCK FOR ALL TRAILERS.
4. MAXIMUM OPERATING PRESSURE = 15 PSIG.



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FIGURE 2 MULTIPLE COMPARTMENT TRAILER



NOTES:

1. FOR INDUSTRIAL TRAILERS, THE CARBON FILL & DISCHARGE CONNECTIONS ARE KAMLOCK STYLE (MALE).
2. FOR FOOD GRADE TRAILERS, THE CARBON FILL & DISCHARGE CONNECTIONS ARE KAMLOCK STYLE (FEMALE).
3. ALL OTHER CONNECTIONS ARE MALE KAMLOCK FOR ALL TRAILERS.
4. MAXIMUM OPERATING PRESSURE = 15 PSIG.



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SECTION 5

GENERAL INFORMATION

SECTION 5

GENERAL INFORMATION

5.1 MAINTENANCE

As preventative maintenance, periodic inspection of the vessel internal parts should be made to ensure that the underdrain, vessel lining, and nozzles are in good condition. As a minimum, the adsorber should be inspected once per year, or during carbon transfers if the on-line period exceeds one year. Any nozzles showing signs of fatigue or surface area restriction due to pluggage of the nozzle slots should be replaced. Nozzles should be physically checked to ensure that they are tightly secured.

Systems with high backwash frequencies and rigorous backwash requirements should be inspected more frequently. The vessel must be fully emptied to allow inspection of the interior of the vessel. Follow the safety guidelines listed in the following sections when entering enclosed vessels. Calgon Carbon Operations personnel should be present during internal vessel inspections.

Pressure gauges should be installed on influent and effluent piping to determine the pressure drop across the carbon bed. Taking periodic pressure readings will give the operator the capability of monitoring the pressure drop across the carbon vessels over time. If a pressure increase is observed, then corrective action can be taken before the pressure drop becomes a problem.

In order to protect the vessel from high pressure, a safety device should be installed. Usually, this device is a rupture disk or pressure relief valve. The rupture disk should be designed to rupture within $\square 5\%$ of the disk's stamped burst pressure. However, repeated pressure swings above the operating ratio pressure (75% of the burst pressure) can cause premature bursting of the disk.

In order to prevent carbon from entering the effluent stream, an optional carbon retainer screen should be installed in the in the effluent line from the adsorber. In the event of an underdrain nozzle failure, the strainer will fill with carbon and the pressure drop will increase to a point where the system flow is reduced. If this should occur, the system should be shut down, emptied, and inspected to determine the cause of the failure.

5.2 SAFETY CONSIDERATIONS

5.2.1 Oxygen Demand Due To Activated Carbon

Studies have shown that low oxygen content exists in vessels containing wet drained granular activated carbon. The laboratory experiments conducted since that time also have revealed that commercial activated carbons in a wet or moist condition will lower the oxygen content of an isolated space.

Preliminary indications of this research are:

- 1) The phenomenon occurs with all types of wet activated carbon.
- 2) The rate of oxygen uptake naturally varies with the degree of exposure of the wet carbon to the air. Thus, it is relatively rapid in a drained bed.
- 3) There is some indication of a limit to the carbon's capacity for oxygen, but until more is known, it would be prudent to assume that all carbons (fresh, used, reactivated) will also exhibit this characteristic. Similarly, although these tests were run with water, it should be assumed that the phenomenon will occur in other liquid and vapor systems.

Based on the properties of wet activated carbon, a confined space entry procedure should be established for any facility using carbon in confined vessels.

All confined spaces, including those containing activated carbon, should be presumed to be hazardous. Appropriate safety measures should always be taken before entering, as well as when workers are in a confined space. OSHA regulations applicable to respiratory protection in oxygen deficient atmospheres should be strictly adhered to.

5.2.2 Emergency Procedures

If a major leak or similar problem develops, flow to the adsorber should be stopped immediately and steps taken to correct the problem. Proper safety procedures should be observed at all times to prevent damage to the equipment or injury to personnel.



5.2.3 Pressure Relief Warning

To avoid vessel damage and endangerment of operating personnel, a pressure relief device should be installed venting to atmosphere.

5.3 RECORD KEEPING

Normally, operating data is taken for: 1) flow rates, 2) which beds are in service, 3) pressure drop across each unit, and 4) necessary analytical work for influent and effluent to each adsorber. This may include: pH, TOC level, BOD, COD, toxicity, organic contaminant levels, and inorganic levels.



SECTION 6

ACTIVATED CARBON / ADSORPTION INFORMATION

SECTION 6

ACTIVATED CARBON / ADSORPTION INFORMATION

6.1 GLOSSARY

The following terms are commonly used to describe adsorption theory, activated carbon, and adsorption systems.

ABRASION NUMBER -- A test performed on a particulate material to define the resistance of the particles to degrade on handling. It is calculated by contacting a sample with steel balls in a Ro-Tap machine and determining the ratio of the final to the original mean particle diameter.

ACTIVATED CARBON -- A carbonaceous material that is a crude form of graphite with a random and amorphous structure. The structure is highly porous, over a broad range of pore sizes, from visible to molecular cracks and crevices.

ACID WASHED ACTIVATED CARBON -- Activated carbon which has been washed with an acid solution for the purpose of dissolving the iron from the carbon. Acid washed carbons are usually used in systems/processes operating at low pH.

ADSORBATE -- Any substance that is or can be adsorbed on the adsorbent.

ADSORBENT -- Any solid having the ability to concentrate significant quantities of other substances on its surface. Activated carbon is an adsorbent.

ADSORBER -- A vessel designed to hold granular activated carbon.

ADSORPTION -- A phenomenon where an adsorbate is physically attracted to the surface of the adsorbent.

ADSORPTION ISOTHERM -- A graphic depiction of the capacity of an adsorbent to adsorb a specific adsorbate. The measurements of capacity are performed at constant temperature using either varying amounts of the adsorbate or adsorbent.

ADSORPTION PORES -- The finest pores in the carbon structure. Pores which have adsorption capacity.

AIR SCOURING -- A process that uses pressurized air to break-up any agglomerations in a carbon bed. Air is blown into the bottom of the bed before the bed is backwashed. Air scouring capability must be incorporated into the system design during the design phase.

APPARENT DENSITY -- A physical property that is defined as the mass per unit volume of a granular material under specified conditions. The apparent density includes the carbon skeleton volume plus the pore and void volumes.

ASH -- The noncombustible mineral matter that is contained in activated carbon and is the residue that remains after the combustion of a carbonaceous material. The measurement of ash is performed under specified conditions and is normally defined on a weight percent basis.

BACKWASH -- An operating method used to remove suspended solids from a carbon bed. Water is pumped into the bottom of the adsorber, flows upward through the carbon bed, and exits through the backwash outlet. The upward flow expands the bed and removes carbon fines, entrained air and suspended solids. The percent bed expansion (up to 50%) and time required for backwashing are a function of the backwash rate and water temperature.

BACKFLUSH -- A process similar to backwashing, but the flow rate is not high enough to expand the bed more than five percent.

CARBON HEEL -- Any quantity of spent carbon not removed from an adsorber before recharging the vessel with fresh carbon.

CARBON TETRACHLORIDE ACTIVITY -- A measurement of the increase in weight of a sample of activated carbon after air saturated with carbon tetrachloride is passed through the sample. The test is performed at a given temperature and the results are reported as weight percent.

CARBON TRAILER -- A bulk trailer used to transport 20,000 pound (or less) loads of granular carbon to/from the customer's plant site.

CHEMISORPTION -- A chemical process that binds an adsorbate to the surface of an adsorbent by forces whose energy levels approximate those of a chemical bond.

COLOR BODIES -- Complex molecules which impart color (usually undesirable) to a solution. Carbon adsorption is often used for color removal applications.

COUNTER-CURRENT OPERATION -- A mode of operation where the flow of liquid is opposite the movement of the adsorbent. This method of operation produces the lowest carbon usage rate or highest efficiency.

CRITICAL BED DEPTH -- The distance between the fresh carbon and the spent carbon for a bed of activated carbon. In other words, it is the portion of the bed which is partially spent and the zone where adsorption takes place. The critical bed depth is measured in feet. For a single column system, this is the amount of carbon that is not completely utilized when the effluent objective is reached and the carbon is taken off-stream.

DEAERATION (WETTING) -- The process of removing air (gases) from a carbon bed and the carbon pores. The volume of air in activated carbon is in the void space and pore volume, which typically accounts for 80% of the total volume in a carbon bed (the carbon skeleton accounts for the other 20%).

DESORPTION -- The opposite of adsorption. A phenomenon where an adsorbed substance leaves the surface of the adsorbent.

EDUCTOR -- A device to motivate a slurry of activated carbon and water slurry through hoses and pipes. An eductor has no moving parts and utilizes pressurized water as the motive force.

FRESH CARBON -- New carbon that is placed into an adsorber. Fresh carbon can be either virgin carbon or newly reactivated carbon.

HARDNESS NUMBER -- A measurement of the resistance of a granular carbon to the degradation action of steel balls in a Ro-Tap machine. This number is calculated by using the weight of granular carbon retained on a particular sieve after the carbon has been in vigorous contact with the steel balls.

HEAT OF ADSORPTION -- The heat given off when molecules are adsorbed.

IODINE NUMBER -- The measurement of the amount of iodine adsorbed by one gram of carbon. The concentration of iodine is 0.02N. The iodine number is reported as milligrams of iodine.

LAG ADSORBER -- The second bed of carbon through which the liquid passes in a series operated adsorption system. The lag vessel contains carbon that is partially spent when the carbon in the lead adsorber is completely spent.

LEAD ADSORBER -- The first bed of carbon through which the liquid passes in a series operated adsorption system. The lead vessel contains carbon that is the first to become spent.

MASS TRANSFER ZONE -- The adsorption gradient that exists in the carbon bed. It corresponds to the gradual transition of the carbon from spent to fresh.

MESH SIZE -- The measurement of the particle size of granular activated carbons determined by the U.S. Sieve Series. Particle size distribution within a mesh series is typically given in the specification of the particular Calgon Carbon's carbon.

MOLASSES NUMBER -- A ratio of the optical densities of a molasses solution treated with a standard activated carbon compared to a molasses solution treated with the activated carbon in question.

MOISTURE -- The measurement of the amount of water adsorbed on activated carbon. Moisture is reported as percent. For Calgon Carbon's coal based products the moisture specification is less than 2% as packed.

PARALLEL FLOW -- The mode of operation when two or more adsorbers are operated so that the influent flow is distributed equally to each adsorber.

PARTICLE DENSITY -- A measurement of the weight per unit volume of granular activated carbon as determined by the displacement of mercury. Particle density is typically reported as g/cc. The particle density includes the carbon skeleton volume plus the pore volume.

POLISH ADSORBER -- See Lag Adsorber.

PORE VOLUME -- A measurement of the volume of pores in a unit weight of carbon. The pore volume is determined by obtaining the difference in the volumetric displacement of carbon in mercury and helium at standard conditions.

PRESSURE RELIEF DEVICE -- A device such as a rupture disk or a pressure relief valve which prevents a vessel from exceeding its design pressure.

REAL DENSITY -- A measurement of the weight per unit volume of the skeleton only of a carbon granule. This measurement excludes the pore volume and the inter-particle void space. This property is determined by helium displacement and is approximately 2.1 g/cc for coal based carbons.

REACTIVATED CARBON (REACT CARBON) -- Granular carbon that has been thermally reactivated for re-use as fresh carbon in adsorption systems.

REACTIVATION -- A process to remove adsorbates from spent granular activated carbons using vaporization and oxidation at temperatures greater than 1000NF. Reactivated carbon can be reused. Depending on the application the performance of the reactivated carbon can be less than, equal to, or better than virgin carbon. This is a type of carbon regeneration.

SERIES FLOW (LEAD-LAG OPERATION) -- A mode of operation where two or more adsorbers are operated so that each adsorber treats the entire influent flow, one after the other. When the carbon in the lead bed is spent, the carbon is replaced with fresh carbon and this adsorber is placed in the lag (polish) position.

SPECIFIC HEAT -- A physical property that is defined as the ratio of the quantity of heat required to raise the temperature of a compound through a particular temperature interval compared to the corresponding heat quantity for water. For Calgon Carbon carbons this value is approximately 0.20 cal/g/NC at temperatures less than 200NC.

SPENT CARBON -- Carbon that has adsorbed organic contaminants and must be removed from the system so that the effluent quality specifications are not exceeded.

SURFACE AREA -- A measurement of the total surface area available for adsorption inside the pores of activated carbon. Surface area is determined by the Brunauer, Emmett, and Teller method (BET Method), which uses the adsorption of nitrogen at liquid nitrogen temperature. Surface area is usually expressed in square meters per gram of carbon. The surface area of Calgon Carbon carbons ranges from 700 to 1200 square meters per gram.

TRANSFER TANK -- A storage tank designed to hold a charge of spent carbon. The purpose of the tank is to save on freight as only one truck is needed to deliver fresh carbon and return the spent carbon for reactivation.

TRANSPORT PORES -- Pores larger than the largest adsorption pores. These pores function as a diffusion path to transport adsorbates. Adsorption does not occur in these pores even at saturated conditions.

UNDERDRAIN -- A device located inside the adsorber to collect the fluid being treated. The underdrain permits the fluid to flow into the piping network while retaining the granular carbon in the vessel.

VENT -- A pipe line from an adsorber or transfer tank to an unrestricted sewer or the atmosphere.

VIRGIN CARBON -- Fresh granular activated carbon that has not been used.

VOIDS -- The space (volume) between the carbon granules. For Calgon Carbon carbons the typical range is 37% to 43% by volume.

WATER CUSHION -- The water added to an adsorber or transfer tank before charging the vessel with carbon. This is done to protect the underdrain, nozzles and lining.

WAVE FRONT -- See Mass Transfer Zone

6.2 ADSORPTION

There are two types of adsorption: chemical and physical.

Chemical adsorption is a chemical reaction between a molecule in a solution or vapor with the surface of an adsorbent such as activated carbon. The chemical reaction is usually irreversible. An example of chemical adsorption is chlorine removal from water. The chemical reaction of chlorine with carbon and water forms Cl^- and CO_3^{2-} ions.

Physical adsorption is usually explained in terms of surface structure (or energy per unit volume) of the solid. While molecules in the interior of any solid material are subject to equal forces in all directions, the molecules on the material's surface are subjected to unbalanced forces. This results in an imbalance with inward forces toward the solids. Molecules that are either gaseous or liquid then become attracted (adsorbed) to the solid's surface.

The attractive forces, known as London Dispersion Forces, are the same forces responsible for surface tension and condensation of vapors to liquid. These forces are a type of Van der Waals force and range from very weak to moderately strong. Physical adsorption is reversible and changing the process variables in a system can cause molecules to be desorbed.

An important aspect to any adsorbent is the amount of pore volume it contains per unit volume or per net weight. Examples of adsorbents are activated carbon, silica gel, activated gel, alumina, and zeolite.

6.3 ACTIVATED CARBON AND HOW IT WORKS

Any organic material with a high carbon content (coal, wood, peat, coconut shells, etc.) can be used as the raw material for making activated carbons of various activities and properties. When making high quality granular activated carbon from coal, the raw material is ground and a binder is added to give the end product suitable hardness. The mixture is then re-compacted and crushed to give it the desired particle size. The carbon is then activated by thermally decomposing and removing carbon from the structure in a reducing atmosphere at about 1800 F. Furnace temperature and the furnace atmosphere are controlled to produce the desired adsorption properties in the product.

The resultant product has an incredibly large internal pore volume per unit particle volume and a network of submicroscopic pores where the adsorption takes place. About 40% of the particle volume is used to contain adsorbates. One pound of activated carbon contains an effective total area of over 100 acres.

Activated carbon normally removes adsorbates (contaminants or desired products) from a solution (solute) through physical adsorption. The adsorbate would have to differ from the solute. For example, in aqueous solutions the solute should be more neutral or non-polar and have a higher molecular weight.

Many factors affect carbon adsorption in liquids, such as pH, flow rate, temperature, solubility, concentration of adsorbate, type and number of different adsorbates, viscosity, and the level of adsorbate removal required.

In any stream, there are four steps that occur in order for adsorption to take place. First, the adsorbate molecule must migrate through the bulk of solution toward the carbon particle. This is known as bulk diffusion. Second, the adsorbate penetrates the surface film to reach the exterior surface of the carbon. This is known as film diffusion. Third, the adsorbate diffuses through the transport or large pores. This is known as pore diffusion. Fourth, the adsorbate is adsorbed deep into the micropore structure of the activated carbon. In most water applications, the rate limiting step is the pore diffusion step.

In a typical fixed bed carbon system, the liquid flows down through an adsorber. Initially, the adsorbate is adsorbed onto the top most portion of the carbon. The rate of adsorption will determine the depth of carbon (mass transfer zone) that is utilized to remove the adsorbates. The varying concentration in the mass transfer zone is known as the wavefront.

Eventually, the wavefront moves through the bed and contamination breaks through into the effluent from the bed. This is known as the breakpoint. In a single or parallel adsorber system, the contaminants are usually monitored until the effluent approaches the allowable limit. The adsorber is then taken off-line and the spent carbon is removed. The adsorber is then refilled with fresh carbon and brought back on-line.

In a series mode, the mass transfer zone in the first or lead bed is allowed to pass through the adsorber into the second bed. Usually, when adsorbing multiple components, the first two or three compounds that are being monitored in the effluent from the lead bed are allowed to approach their influent levels, at which point the adsorber is taken off-line.

6.4 FACTORS AFFECTING ADSORPTION

Concentration: With each adsorbate, a high concentration will result in a higher adsorption capacity for that adsorbate on the carbon. For example, if an adsorbate has a one percent loading at 1 mg/l, it might have a three percent loading at 10 mg/l. However, the volume of carbon required to treat a fixed volume of solution will go up if the concentration goes up.

When the concentration of the feedstream changes dramatically, such as when a spill occurs upstream of a potable water plant intake, undesirable effects may occur. Concentrations at the intake of the plant may go up 100 to 1000 times the normal influent concentration. The activated carbon would adsorb the contamination with a higher capacity, if adsorptive capacity was available.

However, upon passage of the spill past the intake, the activated carbon may desorb some of the high level contamination to fresh carbon downstream of the mass transfer zone or into the effluent. When upsets occur, a conservative approximation is to assume that additional carbon is exhausted by the excess contaminant at the original loading rate for the normal influent level.

Another example is when the contaminant concentration in the influent decreases for a period of time. In this instance the adsorbate will start to desorb. The rate of desorption is slower than the rate of adsorption. Therefore, a conservative estimate of the overall effect is that a fixed volume at the reduced influent level will exhaust as much carbon as if the influent concentration was consistently high.

A steady feed concentration will help minimize the amount of carbon that is used in an application. A steady feed would usually be considered to be +/-25% of the average concentration. However, the carbon bed will act to average out upsets and variations, except when the bed is nearly exhausted.

Flow Rate: In many applications, the flow rate to the adsorber is varied because the flow demand changes. As the flow changes, so does the mass transfer zone (MTZ). These changes are approximated by a directly proportional relationship between MTZ length and flow rate. For example, if the MTZ is 1 foot at 250 gpm, it would be 2 feet at 500 gpm. If the flow rate is increased dramatically, the MTZ is further lengthened because some desorption may take place, resulting in less efficient operation. For the optimum carbon usage, the flow rate should be steady (if possible).

In a series configuration, increasing the flow rate usually has a minimal impact. In a parallel mode, this impact is more substantial since the carbon is usually taken off line on the basis of the effluent quality. since the MTZ is lengthened the on-stream time will be shortened.

Viscosity: As viscosity increases in a system, the time to adsorb lengthens, and thus the MTZ lengthens. In a process application the temperature of the feedstream may be raised to offset increases in viscosity, but if the temperature is raised too high degradation of product may occur or the adsorption capacity of the carbon may be reduced. In water applications, viscosity has minimal impact because it is relatively low.

Temperature: In liquid phase systems, the adsorptive capacity is usually lowered at higher temperatures because the solubility is increased.

Feedstream pH: The pH of the feedstream can impact adsorption efficiency. This impact may be substantial since the pH affects the ionization of the adsorbate. Usually, the more ionic adsorbates have less adsorption capacity. Therefore, organic acids adsorb better at lower pH levels, while organic bases adsorb better at higher pH levels.

Water Characteristics: On each start-up of fresh carbon, the pH of the effluent stream may rise. This occurs because species like sulfates, nitrates and chlorine adsorb and displace alkaline species. The pH will return to normal, depending on water characteristics, after 250 to 350 bed volumes have been treated. If this is a problem, then either acid should be added to the effluent, or the carbon should be allowed to stand in a sodium sulfate solution for 10 to 12 hours.

The carbon has a capacity for sodium sulfate of 1% by weight. Therefore, the water in contact with the carbon should contain a quantity of sodium sulfate at least equal to 2% by weight of the carbon. In a 20,000 pound adsorber this would be 400 pounds of Na_2SO_4 in 5,000 gallons of water.

Solubility: The water solubility of a particular compound is a very good indicator of its adsorptivity. Generally, the more soluble a compound is, the more difficult it is to be adsorbed. Also, a more water soluble compound has a longer MTZ.

Suspended Solids: Suspended solids should usually be taken out of the feedstream before the carbon adsorbers. Suspended solids (>10 microns) will usually be filtered out within the first 6" of carbon and the pressure drop across the carbon will increase. If the pressure drop increases too much, the unit should be backwashed or backflushed. Normally, feed streams containing suspended solids of more than 50 ppm are pre-filtered.

If the suspended solids are finer than 10 microns, the solids will usually not be filtered out by the carbon. The solids would then pass through the carbon into the effluent. This condition is very undesirable because the solids often contain dissolved or attached adsorbate and premature breakthrough can appear to occur. For materials to adsorb they must be in solution, so they can diffuse into the pore structure.

Immiscible Oils and Greases: Immiscible oils and greases have to be separated from the feedstream before the carbon adsorbers. If they are not removed, they may coat the carbon particles with a fine film. The adsorbates will not be able to pass through this film, and the carbon will not be effectively utilized. Oils and grease can also behave as a suspended, immiscible solid.

Heat of Adsorption: Heat is often given off when molecules are adsorbed. The amount of heat is conservatively estimated at two (2) times the heat of vaporization. In a process stream where the solvent is an organic liquid, a heat-up potential exists if the carbon has not been previously wetted and deaerated properly. Refer to Section 3.3 of this manual for wetting procedures.

Water has too low a heat of adsorption to cause a problem for aqueous solutions.

Competitive Adsorption: In most carbon applications (process, wastewater, groundwater, and potable water), more than one adsorbing compound is in the feedstream. Some of these compounds must be adsorbed while others may be permitted to pass through the carbon bed.

Unfortunately, the activated carbon cannot tell which of the molecules must be adsorbed. All of the components in the feedstream will compete for adsorption space, making the removal of target components less efficient. Therefore, competitive adsorption can cause premature breakthrough of the target component.

6.5 ADDITIONAL ADSORPTION THEORY

Desorption/Displacement: Desorption is the opposite of adsorption and may occur for many reasons. Changes in the feedstream components, temperature, pH, and feedstream concentration may promote desorption. In order to minimize desorption and optimize carbon usage, the feedstream should be stable (if possible). The rate at which desorption takes place is usually much slower than the adsorption rate.

If a more strongly adsorbed organic enters the feed it will desorb the target adsorbate. This forces the target adsorbate to re-adsorb deeper in the carbon bed, and eventually breakthrough will occur.

Roll-Over in Competitive Adsorption: When an adsorber system runs beyond breakthrough, the more weakly adsorbed components originally in the feedstream can be desorbed into the effluent. The resulting concentrations may exceed the inlet concentrations. This phenomenon is known as roll-over. In a properly operated column system, roll-over of key components will not be observed in the effluent.

Effect of Bacteria: Higher pressure drops can be a result of bacteria growth in some wastewater applications. This is due to bacteria slime and exhaust gasses from the bacteria. If backwashing does not get rid of the pressure drop problem, then either NaOH washing or higher temperatures will control bacteria growth. Usually, sodium hydroxide washing is used in lined vessels. Do not use biocides, chlorine, or other additives, since they will adsorb and reduce carbon life without affecting the bacteria.

Refer to Section 3.7.2 for sodium hydroxide washing procedures.



SECTION 7

TECHNICAL INFORMATION

SECTION 7

TECHNICAL INFORMATION

7.1 CARBON ACCEPTANCE CANISTER (CAC) INSTRUCTIONS

1. Connect the carbon acceptance canister (CAC) as shown on the drawing below. Start the adsorption system according to the operating manual. All valves in the influent and effluent lines to the CAC should be closed.
2. Open the top 2" plug on the CAC. Slowly fill the CAC with clean, hot water. If hot water is not available, ambient temperature water will be acceptable. Capacity of the CAC is approximately one (1) gallon.
3. For optimum performance, the water needs to be adsorbed into the carbon. To achieve this, allow the CAC to stand full with water for approximately 24 hours. After the water has been adsorbed, replace the plug in the top of the CAC.
4. Open both valves in the CAC effluent line. One valve, C-4, is located near the adsorption system's main effluent header and the other valve, C-3, is located near the CAC.
5. Disconnect the tubing on the CAC influent line at the isolation valve C-1 located on the system's main influent header.
6. Slowly open the CAC influent valve, C-2, to allow clean effluent water to back flow through the CAC to purge the lines and backflush the CAC. Allow about 5 gallons of clean water to flow through the CAC.
7. Close the valve, C-2, in the CAC influent line to stop the flow. Reconnect the tubing to the CAC influent isolation valve, C-1.
- 8.; Slowly open both of the valves in the CAC influent line to allow untreated water to flow through the CAC.
9. If the carbon adsorption system is to be backwashed or shutdown, close the influent valve, C-2, and the effluent valve, C-3, on the CAC, and open the top plug in the canister to vent the CAC. Once the adsorption system is placed back into service, tighten the plug and open the CAC influent and effluent valves.

10. The CAC should be left in service according to the following guidelines:
 - a. If the adsorption system is operating in parallel mode, the CAC should be left on-line for about 1/10 th of the anticipated bed life.
 - b. If the adsorption system is operating in series mode, the CAC should be left on-line for about 1/5 th of the anticipated bed life.
11. After the CAC has been on-line for the recommended time period, it needs to be returned for carbon acceptance testing. The CAC is taken out of service by closing all of the valves in both the CAC influent and effluent lines. After the valves are closed, disconnect the effluent tubing connector at the CAC. Slowly open the top plug to vent the CAC. Slowly open the CAC effluent valve, C-3, and drain the water from the CAC to a suitable container. Ensure that all necessary safety precautions are taken depending on the hazardous nature of the process liquid. Open the CAC influent valve C-2 and carefully disconnect the tubing from the influent isolation valve, C-1, on the system header. Allow the liquid in the influent tubing to drain through the CAC and into the container.
12. Close the CAC influent valve C-2 and effluent valve C-3. Replace the top plug and remove the CAC from the adsorption system. Ship the CAC with the influent and effluent valves attached and closed. This is required to ensure that no water leaks from the CAC during shipment.

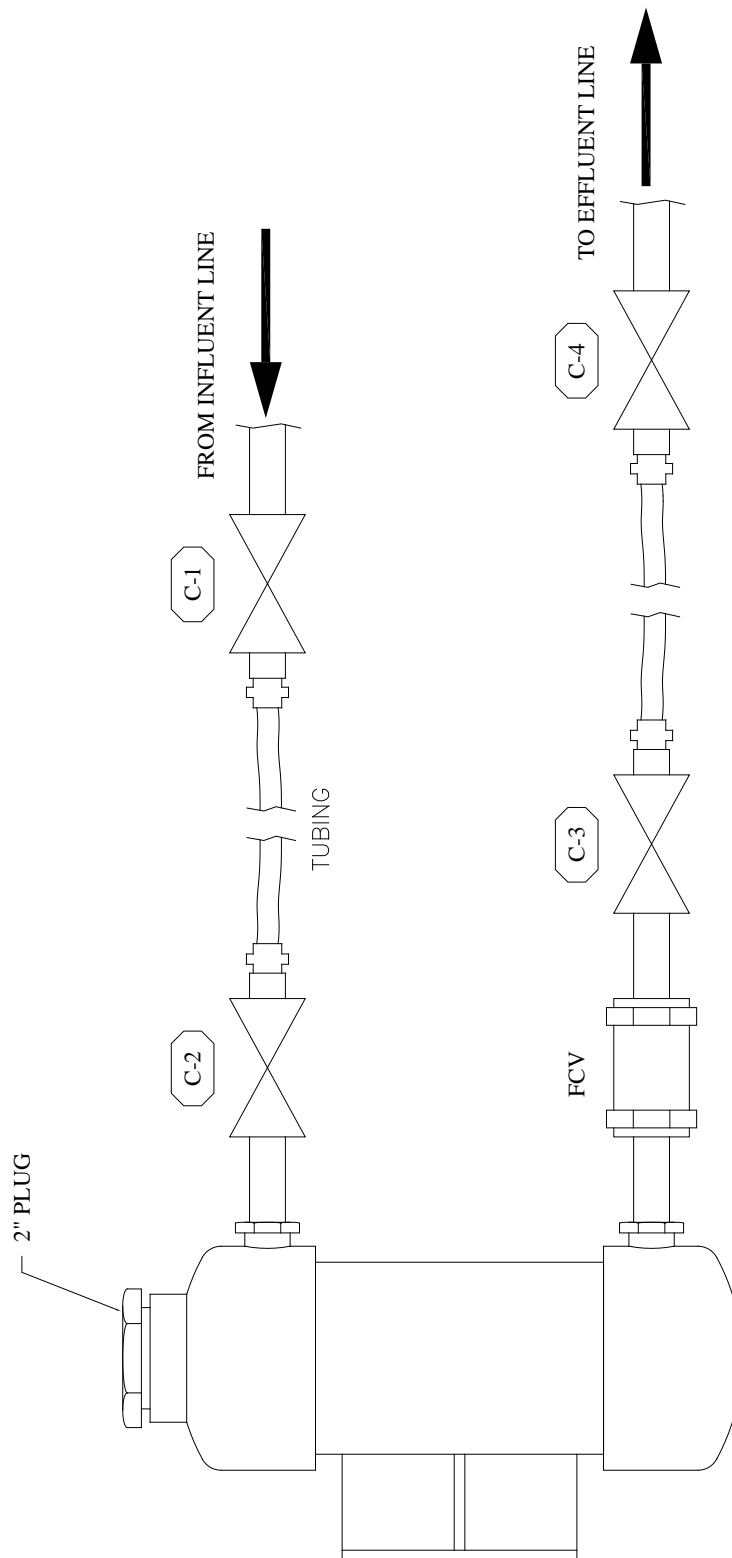
Ship the CAC to: Calgon Carbon Corporation
500 Calgon Carbon Drive
Pittsburgh, PA 15205
Attention: Carbon Acceptance

Contact the Calgon Carbon Sales Office in your area for additional information.

Unit Specifications

Max. Operating Pressure:	125 psig
Body and Septa:	PVC
Valves	PPL
Tubing	PPL
Flow Control Valve	Nickel Plated Brass

MEDIA ACCEPTANCE CANISTER



- C-1 - MAC INFLUENT BLOCK VALVE
- C-2 - MAC INFLUENT VALVE
- C-3 - MAC EFFLUENT VALVE
- C-4 - MAC EFFLUENT BLOCK VALVE
- FCV - FLOW CONTROL VALVE (1 GPM)

7.2 MATERIALS OF CONSTRUCTION

WETTED CONTINUOUSLY		
ITEM	CCC SPECIFICATION NUMBER	MATERIAL OF CONSTRUCTION
Carbon Fill Piping	S25	Sch.40 Stainless Steel Pipe & Fittings
Carbon Discharge Piping	S25	Sch.40 Stainless Steel Pipe & Fittings
Carbon Exchange Valves	4.08	316SS Body, Ball and Stem TFE Seats and Seals
Flush Connection Piping	C13 G46	Sch. 40 Galvanized Carbon Steel Galvanized Iron Fittings EPDM Gaskets
Flush Connection Valves	4.03	Bronze/Brass Body, Ball and Stem TFE Seats and Seals
Undercone Vent Piping	S15	Sch. 40 316 SS Pipe & Fittings
Undercone Vent Valves	4.57	316 SS Body, Ball and Stem TFE Seats and Seals
Vessel Lining	--	Plasite 4110, Vinyl Ester
Vessel Manway Gaskets	G46	EPDM
Underdrain Materials	22.96	PPL
WETTED INTERMITTENTLY OR FOR SHORT TIME PERIODS		
Quick Connect Couplings	32.60 32.61	Aluminum Aluminum



7.3 SINGLE MODEL 10 SPARE PARTS LIST

PART IDENTIFICATION	PART NUMBER	SHIP WEIGHT	RECOMMENDED QUANTITY	QUANTITY ORDERED
GASKETS				
4" Ring, 1/8" thk, EPDM		.25	2	
20" Manway, Full Face EPDM		.25	2	
Gasket - 14x18 Elliptical, EPDM	5	1	1	
VALVES				
Valve - 4" Stainless Steel Ball	1001638	67	1	
Valve - 3/4" Brass	1001636	1	1	
MISCELLANEOUS				
Hose Fitting - 3/4" Aluminum		.25	1	
Hose Fitting - 4" Aluminum	1001309	2	2	
Underdrain Nozzle -PPL	1001386	.25	50	

REFERENCE PURCHASE ORDER NUMBER: _____ TOTAL PRICE: \$ _____

SHIPPING: NORMAL _____ RUSH _____ OTHER _____ AMOUNT \$ _____

SHIP TO: _____ BILL TO: _____

TOTAL ORDER AMOUNT \$ _____ (MINIMUM ORDER \$200 -- SALES TAX ADDED UNLESS EXEMPT)

AUTHORIZED BY: _____

FOR USE BY CALGON CARBON CORPORATION ONLY

PRODUCT CODE: _____ CCC PROJECT NUMBER: _____

7.4 CALGON CARBON CORPORATION SPARE PARTS PROGRAM

INTRODUCTION: Calgon Carbon Corporation has developed a standard product line of engineered treatment systems for air and water applications. Much of the fabrication, and assembly of these systems is done at Calgon Carbon's own facility; therefore most of the system parts and components are maintained in inventory. As a service to customers to provide a source of specified parts in a timely manner, these parts and components are available for purchase. Prices are valid for one year from the date on the list, after this time, the prices may be subject to revision.

ORDER ENTRY: The purchase order for spare parts should be entered using the spare parts order form provided. This form should be sent to:

**Calgon Carbon Corporation
Order Service Department
P.O. Box 717
Pittsburgh, PA 15230-0717**

Orders can also be placed via fax to 1-412-787-6323

Verbal orders can be placed by calling the Order Services Department at 1-412-787-6700

SHIPPING: Order shipping options are either Rush (next day delivery by UPS) or Normal (one week delivery by UPS). Other shipping directions should be requested at the time of ordering. Shipping charges will be added to the total price of the order.

SALES TAX: Sales tax will be added to the invoice unless a sales tax exemption certificate is provided with the order.

PAYMENT: An invoice will be sent to the billing address upon shipment of the order. Payment terms are net 30 days after shipment.

WARRANTY: Calgon Carbon Corporation warrants that the equipment sold hereunder shall be free of defects in material and workmanship for a period of one (1) year from the date of shipment. This warranty does not apply to problems associated with normal wear and tear, improper maintenance, negligence, misuse, abuse or failure to operate the equipment in strict accordance with the operating and maintenance plan provided. For those items provided by, but not directly manufactured by Calgon Carbon, the manufacturer's warranty shall apply, provided warranty coverage exceeds that which is provided by Calgon Carbon. All other warranties, either expressed or implied, are hereby disclaimed, including, but not limited to, the warranty of merchantability and fitness for the particular purpose.

LIMITATIONS OF LIABILITY: The purchaser's exclusive remedy for any cause of action arising out of this transaction, including but not limited to breach of warranty, negligence and /or indemnification, is expressly limited to the maximum of the purchase price of the equipment sold hereunder. All claims of whatsoever nature shall be deemed waived unless made in writing within forty-five (45) days of the occurrence giving rise to the claim. In no event shall Calgon Carbon for any reason or pursuant to any provision of the warranty be liable for the incidental or consequential damages, or damages in excess of the purchase price of the equipment supplied, loss of profit, or fines imposed by Government agencies.

Disinfection Of Granular Activated Carbon



CALGON CARBON CORPORATION

Introduction

There are situations where it becomes necessary to disinfect granular activated carbon (GAC) beds due to the presence of bacteria. The bacteria are usually present because of oxygen depletion in wastewater and potable water applications, and low temperatures (>140°F) in food-related applications (sugars, etc.). The procedure described below is intended for in situ disinfection of carbon in an adsorber containing 20,000 pounds of GAC. By adjusting the amount of sodium hydroxide, larger or smaller carbon beds can be disinfected with this procedure.

Caution Due to the hazardous nature of sodium hydroxide (NaOH) and hydrochloric acid (HCl), appropriate protective clothing such as a face shield, goggles, gloves and impervious clothing must be worn when handling these chemicals. For specific instructions, refer to your plant procedures and/or material safety data sheets for these chemicals. Materials of construction must be compatible with NaOH and HCl.

Disinfection

1. Take the adsorber off line and make sure that a line on top of the adsorber is open to serve as a vent.
2. Drain the water from the adsorber through the adsorber effluent line.
3. Pump 5% sodium hydroxide into the adsorber through the effluent line. For Calgon Carbon's backwashable Model 10 and Model 12 adsorbers, the required volumes are 7,000 and 6,000 gallons, respectively. See step 9a for an alternate procedure.
4. Stop pumping when the NaOH solution overflows through the vent line.
5. Allow the carbon to soak in the sodium hydroxide for at least four hours.
6. Drain NaOH solution from the adsorber through the adsorber effluent line.

Neutralization

7. Wash the carbon by adding contaminant-free or clean water through the effluent line for 7-10 hours at a flow of 1.3-3 gpm/ft² in order to wash out the residual sodium hydroxide and neutralize the carbon. The disinfection is then complete.
- 8a. An alternate, faster procedure for neutralizing the carbon includes acid treatment. After the sodium hydroxide solution is drained from the adsorber, pump 5 gallons of reagent grade hydrochloric acid (37% HCl) into the adsorber through the effluent line.

- 8b. Fill the adsorber with clean water by backfilling through the effluent line at 3-5 gpm/ft² so as to thoroughly mix the content of the adsorber. Shut off the backfill water when it begins to overflow through the vent line.
- 8c. Allow the carbon to soak for 60 minutes, then drain the adsorber. Check the pH of the water, which should be in the range of 8 to 10.
- 8d. Wash the carbon by adding clean water through the effluent line at a rate of 1.3-3 gpm/ft² until the pH of the effluent water matches the influent water or within desired pH range. Disinfection is then complete.

Alternate Disinfection Procedure

- 9a. After step 2, add ~ 1,000 gallons of clear water through the effluent line.
- 9b. After completing step 9a, pump the contents of two 55-gallon drums of 50% sodium hydroxide into the adsorber through the effluent line.
- 9c. Fill the adsorber with clean water by backfilling through the effluent line at 3-5 gpm/ft² so as to thoroughly mix the contents of the adsorber.
- 9d. Shut off the backfill water when it begins to overflow through the vent line. Check the pH of the water exiting the vent line. It should be 13 or higher.
10. Go to step 5.

Safety Message

Wet activated carbon preferentially removes oxygen from air. In closed or partially closed containers and vessels, oxygen depletion may reach hazardous levels. If workers are to enter a vessel containing carbon, appropriate sampling and work procedures for potentially low oxygen spaces should be followed, including all applicable Federal and State requirements.



CALGON CARBON CORPORATION

Calgon Carbon Corporation
P.O. Box 717
Pittsburgh, PA USA 15230-0717
1-800-422-7266
Tel: 412-787-6700
Fx: 412-787-6713

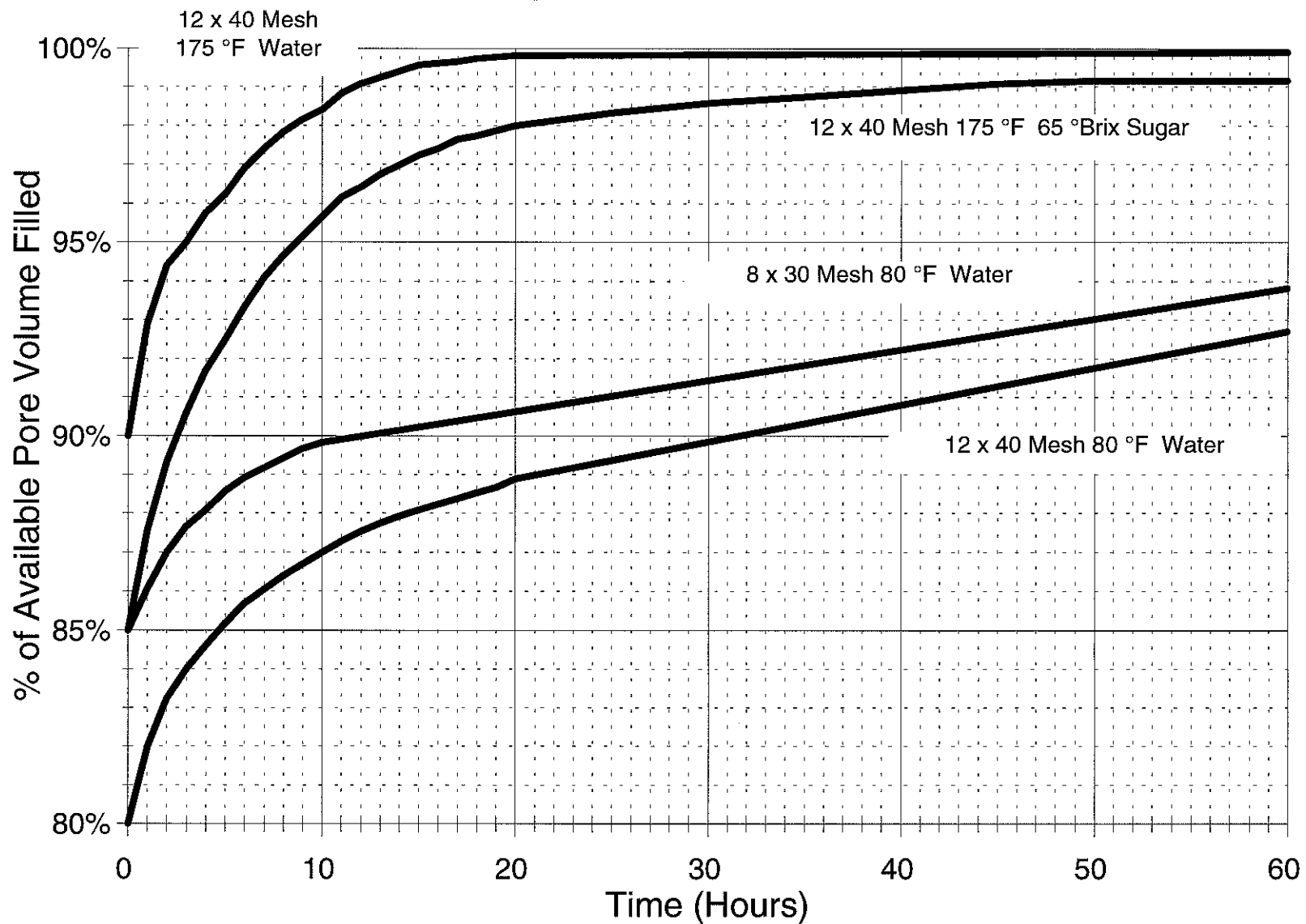
Making Water and Air Safer and Cleaner

Chemviron Carbon
European Operations of
Calgon Carbon Corporation
Zoning Industriel C de Feluy
B-7181 Feluy, Belgium
Tel: + 32 (0) 64 51 18 11
Fx: + 32 (0) 64 54 15 91

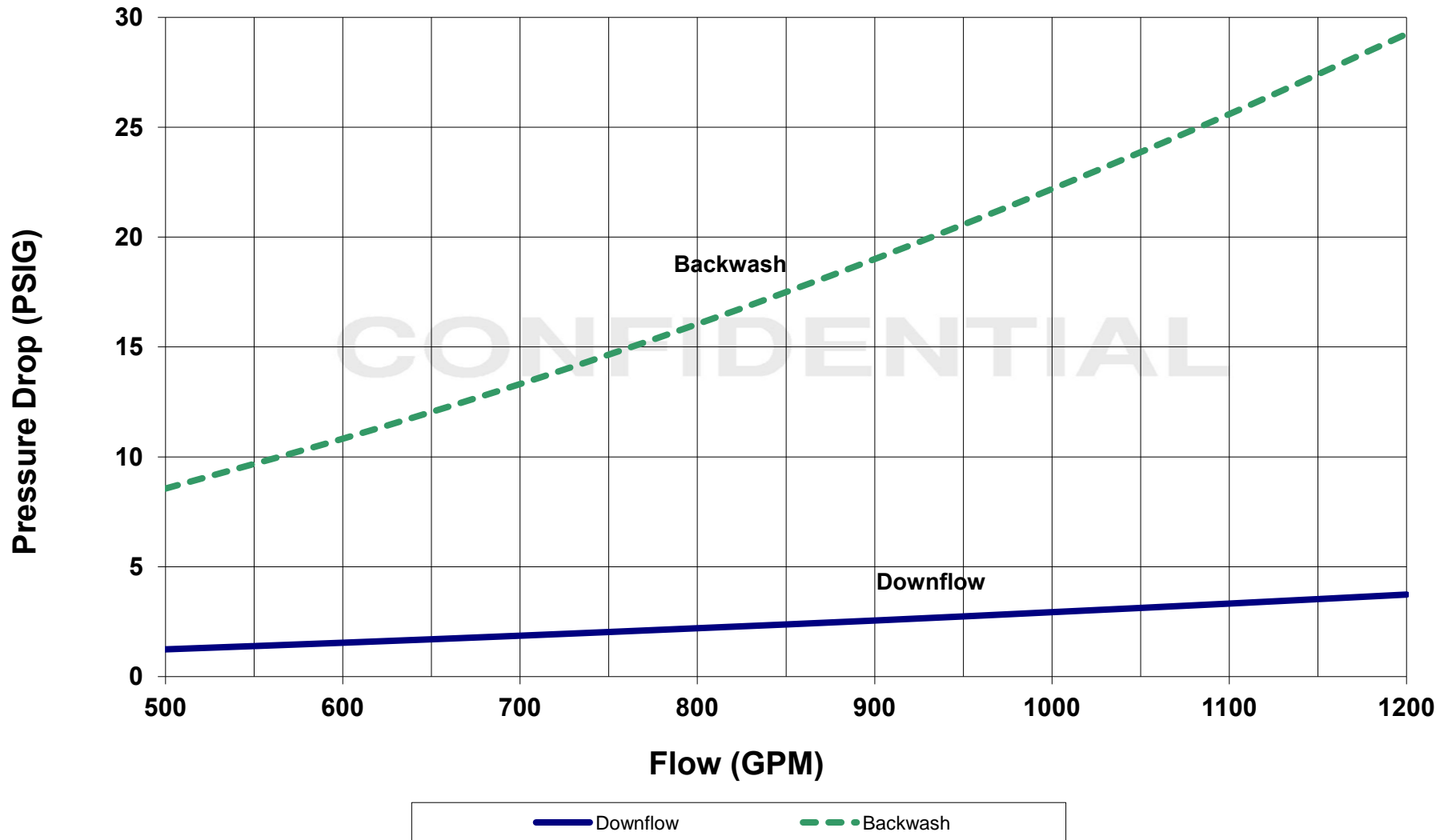
Calgon Carbon Asia
65 Chulia Street
#37-03 OCBC Centre
Singapore 049513
Tel: +65 6 221 3500
Fx: +65 6 221 3554

Your local representative

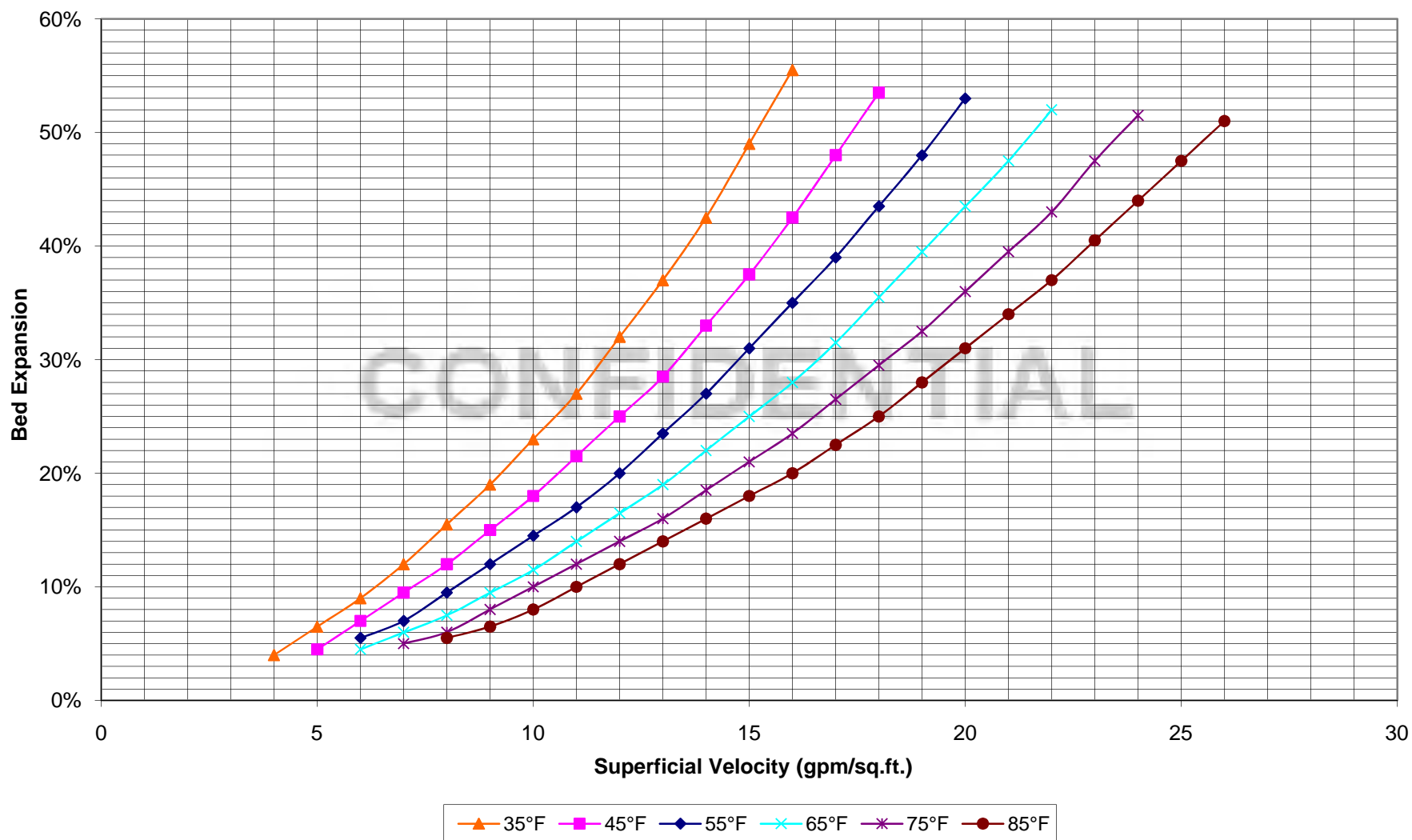
Wetting Times for GAC



Pressure Drop Curve
Custom Flow Model 10, 20,000 # F-300AR Carbon
8" Piping, 60° F., 80 Spec. 22.96 septas



F300 (8x30) - Bed Expansion Backwashed & Segregated



FORM U-1A MANUFACTURER'S DATA REPORT FOR PRESSURE VESSELS
 (Alternative Form for Single Chamber, Completely Shop or Field Fabricated Vessels Only)
 As Required by the Provisions of the ASME Code Rules, Section VIII, Division 1

7966

1 Manufactured and certified by SOUTH GATE ENGINEERING LLC 13477 YORBA AVE CHINO, CALIFORNIA 91710
 (Name and address of manufacturer)
 Manufactured for CAIGION CARBON CORPORATION, P.O. Box 717, Pittsburg, PA 15258
 (Name and address of purchaser)

2 Location of installation Unknown
 (Name and address)

3 Type VERTICAL 16910-16916 - 7966 9208-9214 2001
 (Height or vert. tank) (Mfg's serial No.) (CRN) (Drawing No.) (Nat'l Bd. No.) (Year built)

4 The chemical and physical properties of all parts meet the requirements of material specifications of the ASME BOILER AND PRESSURE VESSEL CODE. The design, construction, and workmanship conform to ASME Rules, Section VIII, Division 1 2001
 Year

5a 2002 - -
 Addenda (Date) Code Case Nos. Special Service per UG 120(a)

6 Shell SA-516 Gr 70 .500" - 10'-00" O.D. 11'-9"
 Mat'l (Spec No., Grade) Nom. Thk. (in.) Corr. Allow. (in.) Diam. I.D. (ft. & in.) Length (overall) (ft. & in.)

7 Seams: TYPE 1 Spot 85% - TYPE 1 Spot 2
 Long (Welded, Ool., Singl. Lap Butt) RT (Spot or Full) EH (%) HT Temp. (°F) Time (hr) Girth (Welded, Ool., Singl., Lap, Butt) RT (Spot, Partial, or Full) No. of Courses

8 Heads: (a) Mat'l SA-516 Gr 70 (b) Mat'l SA-516 Gr 70
 (Spec No., Grade) (Spec No., Grade)

	Location (Top, Bottom, Ends)	Minimum Thickness	Corrosion Allowance	Crown Radius	Knuckle Radius	Elliptical Ratio	Conical Apex Angle	Hemispherical Radius	Flat Diameter	Side to Pressure (Convex or Concave)
(a)	TOP	.385"	-	-	-	2:1	-	-	-	CONCAVE
(b)	BOTTOM	.440"	-	-	-	2:1	-	-	-	CONCAVE

If removable, bolts used (describe other fastenings) -
 (Mat'l, Spec. No., Gr. Size, No.)

9 MAWP 125 psi at max. temp. 140 °F
 Min. design metal temp. -20 °F at 125 psi Hydro. 163 psi test pressure

10 Nozzles, inspection and safety valve openings:

Purpose (Inlet, Outlet, Drain)	No.	Diam. or Size	Type	Mat'l	Nom. Thk.	Reinforcement Mat'l	How Attached	Location
Carbon Outlet	1	4"	PIPE/FFSO	SA-106 GR B	SCH 160	-	UW 16.1(i)	HEAD
Carbon Inlet	1	4"	PIPE/FFSO	SA-106 GR B	SCH 160	-	UW 16.1(e)	HEAD
Influent	1	8"	PIPE/FFSO	SA-106 GR B	SCH 40	SA-516 Gr 70	UW 16.1(q)	HEAD
Effluent	2	8"	PIPE/FFSO	SA-106 GR B	SCH 40	SA-516 Gr 70	UW 16.1(q)	HEAD
Manway	1	14"X18"	PIPE	SA-106 C	.750"	SA-516 Gr 70	UW 16.1(r)	HEAD
Manway	1	20"	PIPE/PLFLG	SA-106 GR B	SCH STD.	SA-516 Gr 70	UW 16.1(q)	SHELL
Sample Ports	4	2"	PIPE/FFSO	SA-106 GR B	SCH 40	-	UW 16.1(c)	SHELL

11 Supports: Skirt NO Lugs 4 Legs 4 Other W8"X40# BEAMS Attached SHELL/HEAD WELDED
 (Yes or no) (No.) (No.) (Describe) (Where and how)

12 Remarks: Manufacturer's Partial Data Reports properly identified and signed by Commissioned Inspectors have been furnished for the following items of the report: -

SGE# 7966 CARBON ADSORBERS
 (Name of part, item number Mfg's name and identifying stamp)

SIZE AND LOCATION OF RELIEF VALVE BY END USER

IMPACT TEST EXEMPT PER UG-20(f)

CERTIFICATE OF SHOP / FIELD COMPLIANCE

We certify that the statements made in this report are correct and that all details of design, material, construction, and workmanship of this vessel conform to the ASME Code for Pressure Vessels, Section VIII, Division 1 "U" Certificate of Authorization No. 1912 expires 8/29/2004

Date 05-01-03 Co Name SOUTH GATE ENGINEERING LLC Signed [Signature]
 (Manufacturer) (Representative)

CERTIFICATE OF SHOP / FIELD INSPECTION

Vessel constructed by SOUTH GATE ENGINEERING, LLC at CHINO, CA 91710
 I, the undersigned, holding a valid commission issued by The National Board of Boiler and Pressure Vessel Inspectors and the State or Province of CA and employed by HARTFORD STEAM BOILER INSPECTION & INSURANCE CO. (HSB CT) have inspected

the component described in this Manufacturer's Data Report on 5/1/03, and state that, to the best of my knowledge and belief, the Manufacturer has constructed this pressure vessel in accordance with ASME Code, Section VIII, Division 1. By signing this certificate neither the Inspector nor his employer makes any warranty, expressed or implied, concerning the pressure vessel described in this Manufacturer's Data Report. Furthermore, neither the Inspector nor his employer shall be liable in any manner for any personal injury or property damage or a loss of any kind arising from or connected with this inspection

Date 5/1/03 Signed [Signature] Commissions NATB 694, CA-1275
 (Authorized Inspector) (Nat'l Board (incl. endorsements) State, Prov. and No.)

FORM U-1A MANUFACTURER'S DATA REPORT FOR PRESSURE VESSELS
(Alternative Form for Single Chamber, Completely Shop-Fabricated Vessels Only)
As Required by the Provisions of the ASME Code Rules, Section VIII, Division 1

1. Manufactured and certified by SOUTH GATE ENGINEERING LLC 13477 York Avenue, Chino, California 91710
(Name and address of manufacturer)

Manufactured for GALCON CARBON CORPORATION, P.O. Box 717, Pittsburg, PA 15258
(Name and address of purchaser)

3. Location of installation Unknown
(Name and address)

4. Type: VERTICAL 17002-17009 8004 9294-9301 2003
(Name or work tank) (Welding symbol) (CRP) (Drawing no.) (Full Dwg. No.) (Full build)

5. The chemical and physical properties of all parts meet the requirements of material specifications of the ASME BOILER AND PRESSURE VESSEL CODE. The design, construction, and workmanship conform to ASME Rules, Section VIII, Division 1 2001
Year

6. Shell: SA-516 Gr 70 .500" 10'-00" O.D. 11'-9"
Matl. (Spec No., Grade) Nom. Thk. (in.) Corr. Allow. (in.) Diam. I.D. (ft. & in.) Length (overall) (ft. & in.)

7. Seams: TYPE I Spot 85% TYPE I Spot 2
Long. (Welded, Dbl., R.T. (Spot or Full) E.W. (%) H.T. Temp (F) Time (hr) Girth (Welded, Dbl., Spot, Lap, Butt) R.T. (Spot, Partial, or Full) No. of Courses

8. Heads: (a) Matl. SA-516 Gr 70 (b) Matl. SA-516 Gr 70
(Spec No., Grade) (Spec No., Grade)

	Location (Top, Bottom, End)	Minimum Thickness	Corrosion Allowance	Crown Radius	Knuckle Radius	Elliptical Ratio	Conical Apex Angle	Hemispherical Radius	Flare Diameter	Side to Pressure (Convex or Concave)
(a)	TOP	.385"	-	-	-	2:1	-	-	-	CONCAVE
(b)	BOTTOM	.440"	-	-	-	2:1	-	-	-	CONCAVE

If removable, bolts used (describe other fastenings) _____

9. MAWP 125 psi at max. temp. 140 °F
Min. design metal temp. -20 °F at 125 psi Hydro., 163 psi test pressure

10. Nozzles, inspection and safety valve openings:

Purpose (Inlet, Outlet, Drain)	No.	Diam. or Size	Type	Matl.	Nom. Thk.	Reinforcement Matl.	How Attached	Location
Carbon Outlet	1	4"	PIPE/FFSO	SA-106 GR B	SCH.160	-	UW 16.1(i)	HEAD
Carbon Inlet	1	4"	PIPE/FFSO	SA-106 GR B	SCH.160	-	UW 16.1(d)	HEAD
Influent	1	8"	PIPE/FFSO	SA-106 GR B	SCH.40	SA-516 Gr 70	UW 16.1(g)	HEAD
Effluent	2	8"	PIPE/FFSO	SA-106 GR B	SCH.40	SA-516 Gr 70	UW 16.1(g)	HEAD
Manway	1	14"X18"	RING	SA-106 C	.750"	SA-516 Gr 70	UW 16.1(r)	HEAD
Manway	1	20"	PIPE/PL. FLG.	SA-106 GR B	SCH. STD.	SA-516 Gr 70	UW 16.1(q)	SHELL
Sample Ports	4	2"	PIPE/FFSO	SA-106 GR B	SCH.40	-	UW 16.1(e)	SHELL

11. Supports: Skirt NO Lugs 4 Legs 4 Other WBX40# BEAMS Attached SHELL/HEAD, WELDED
(Yes or no) (No.) (No.) (Describe) (Where and how)

12. Remarks: Manufacturers Partial Data Reports properly identified and signed by Commissioned Inspectors have been furnished for the following items of the report: _____

SGEN 8004 CUST. P.O.# 4500069031 / ADSORBER VESSELS
SIZE AND LOCATION OF RELIEF VALVE BY END USER
IMPACT TEST EXEMPT PER UG-20(f)

CERTIFICATE OF SHOP / FIELD COMPLIANCE

We certify that the statements made in this report are correct and that all details of design, material, construction, and workmanship of this vessel conform to the ASME Code for Pressure Vessels, Section VIII, Division 1. "U" Certificate of Authorization No. 1912 expires 8/29/2004

Date 11-10-03 Co. Name SOUTH GATE ENGINEERING LLC Signed [Signature]
(Manufacturer) (Representative)

CERTIFICATE OF SHOP / FIELD INSPECTION

Vessel constructed by SOUTH GATE ENGINEERING, LLC at CHINO, CA 91710

I, the undersigned, holding a valid commission issued by The National Board of Boiler and Pressure Vessel Inspectors and the State or Province of CA and employed by HARTFORD STEAM BOILER INSPECTION & INSURANCE CO. (HSB CT) have inspected the component described in this Manufacturer's Data Report on 11/10/03, and state that, to the best of my knowledge and belief, the Manufacturer has constructed this pressure vessel in accordance with ASME Code, Section VIII, Division 1. By signing this certificate neither the Inspector nor his employer makes any warranty, expressed or implied, concerning the pressure vessel described in this Manufacturer's Data Report. Furthermore, neither the Inspector nor his employer shall be liable in any manner for any personal injury or property damage or a loss of any kind arising from or connected with this inspection.

Date 11/10/03 Signed [Signature] Commission KB2669A CA-1275
(Authorized Inspector) (NAB Board, (incl. endorsements) State, Prov. and No.)



SECTION 8

CARBON DATA

FILTRASORB® 300

Granular Activated Carbon for Municipal Specifications



Description

FILTRASORB® 300 is a granular activated carbon developed by Calgon Carbon Corporation for the removal of taste and odor compounds, disinfection by-product precursors, and other dissolved organic compounds from potable water.

This activated carbon is made from selected grades of bituminous coal to produce a high activity, durable granular product capable of withstanding the abrasion associated with repeated backwashing, air scouring, and hydraulic transport. Activation is carefully controlled to produce an equal blend of both low energy pores as measured by iodine number and high energy pores as measured by trace capacity number for effective adsorption of a broad range of high and low molecular weight organic contaminants. The higher density of this activated carbon results in a greater adsorptive capacity per filter volume as measured by the volume iodine number. The product is also formulated to comply with all the applicable provisions of the AWWA Standard for Granular Activated Carbon, edition B604-05, the stringent extractable metals requirements of ANSI/NSF Standard 61, and the Food Chemicals Codex.

Specifications

Specifications	Value
Iodine Number.	900 mg/g (min)
Moisture by weight	2% (max)
Effective size	0.8 - 1.0 mm
Uniformity Coefficient	2.1 (max)
Abrasion No.	78 (min)
Trace Capacity Number	10 mg/cc (min)
Screen Size by weight, US Sieve Series	
On 8 mesh	15% (max)
Through 30 mesh	4% (max)

Typical Property

Typical Property	Value
Apparent Density	0.56 g/cc
Ash by weight	7%

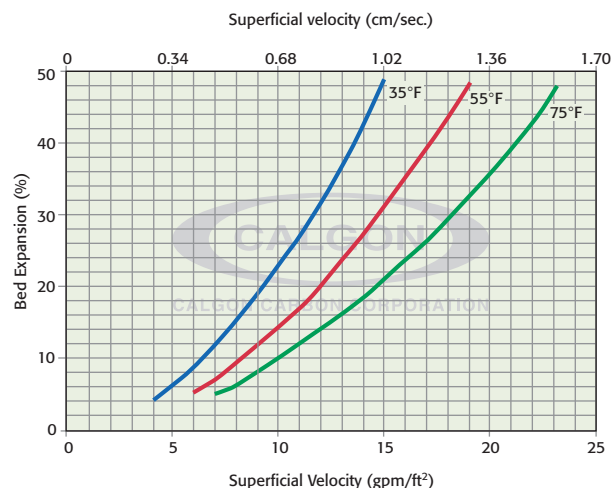
Features

Bituminous-based raw material	Provides higher hardness relative to other raw materials reducing the generation of fines and product losses during backwashing.
Coal is pulverized and reagglomerated with suitable binder	<p>Pore structure provides an equal blend of low and high energy pores for effective removal of a broad range of high and low molecular weight organic compounds.</p> <p>Has a high density, resulting in a greater adsorption capacity per filter volume, wets readily, and does not float, thus minimizing loss during backwash operations.</p> <p>Creates optimal transport paths for faster adsorption.</p>

Benefits

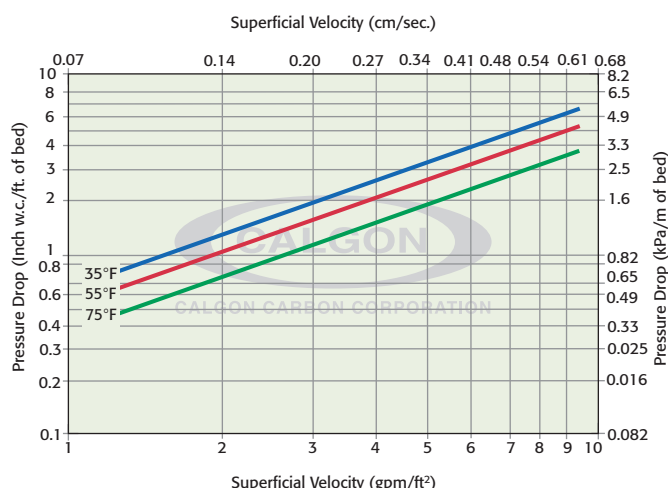
Bed Expansion

Based on backwashed and segregated bed



Pressure Drop

Based on backwashed and segregated bed



FILTRASORB® 300

Granular Activated Carbon for Municipal Specifications



Applications

FILTRASORB® 300 activated carbon can be used to treat surface and groundwater sources for the production of drinking water. This product can be used as a complete replacement for sand and anthracite media. FILTRASORB® 300 activated carbon functions as a dual purpose media, providing both filtration and adsorption. FILTRASORB® has been used successfully in drinking water applications for over 40 years.

Design Considerations

As a replacement for existing filter media, conversion to FILTRASORB® 300 granular activated carbon imposes no major changes to a plant's normal filtration operations. Calgon Carbon Corporation can also provide complete modular adsorption systems as an add-on treatment stage if required.

Safety Message

Wet activated carbon preferentially removes oxygen from air. In closed or partially closed containers and vessels, oxygen depletion may reach hazardous levels. If workers are to enter a vessel containing carbon, appropriate sampling and work procedures for potentially low oxygen spaces should be followed, including all applicable Federal and State requirements.



Calgon Carbon Corporation
P.O. Box 717
Pittsburgh, PA USA 15230-0717
1-800-422-7266
Tel: 1-412-787-6700
Fx: 1-412-787-6713

Making Water and Air Safer and Cleaner

Chemviron Carbon
European Operations of
Calgon Carbon Corporation
Zoning Industriel C de Feluy
B-7181 Feluy, Belgium
Tel: + 32 (0) 64 51 18 11
Fx: + 32 (0) 64 54 15 91

Calgon Carbon Asia PTE LTD
9 Temasek Boulevard
#08-01A Suntec Tower Two
Singapore 038989
Tel: + 65 6 221 3500
Fx: + 65 6 221 3554

Your local representative

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Material Safety Data Sheet

U.S. Department of Labor
Occupational Safety and Health Administration
This form is consistent with ANSI standard for
preparation of MSDS's in accordance with
OSHA's Hazard Communication Standard,
29 CFR 1910.1200.

Product Type: FILTRASORB 300 AR	
Product Code: 1978	Profile No: 1
Effective Date: December 30, 2011	Supersedes: January 17, 2011


SECTION I - PRODUCT AND COMPANY INFORMATION

Product Name	Activated Carbon (Coal Based)	
Product Use	Used according to manufacturer's recommendation	
Company Identification (USA)	Calgon Carbon Corporation P.O. Box 717 Pittsburgh, PA 15230-0717	
Telephone Number(s)	Information	412-787-6700
	Emergency	412-787-6700
Company Identification (Europe)	Chemviron Carbon Zoning Industriel de Feluy B-7181 Feluy, Belgium	
Telephone Number(s)	Information	32 64 51 18 11
	Emergency	32 64 51 18 11
Date Prepared	Signature of Preparer (optional)	
March 22, 2012		

SECTION II – HAZARD(S) IDENTIFICATION

OSHA Regulatory Status:		Not regulated	
HMIS Ratings:	Health	0	4 = Extreme/Severe 3 = High/Serious 2 = Moderate 1 = Slight 0 = Minimum W = Water Reactive OX = Oxidizer
(NFPA)	Flammability	1	
	Reactivity	0	
	Special		
Protective Equipment :		Safety glasses with side shields or goggles, gloves, long sleeve shirt or lab coat, long pants recommended.	
Health Effects:		See Section IV.	
Environmental Effects:		See Section XII.	

GHS Classification:

Hazard Symbol	Hazard / Category	Warning
	Eye Irritation Category 2B Respiratory Irritation Category 3	Contact may cause eye irritation. Dust may be slightly irritating to eyes and respiratory tract. Wet activated carbon removes oxygen from air causing a severe hazard to workers in enclosed or confined space.
Precautionary Statements		
Prevention:	Avoid generation of dust during handling. Avoid breathing dust. Wash thoroughly after handling. Use in a well-ventilated area.	
Response:	IF INHALED: Remove to fresh air and keep at rest in a position comfortable for breathing. IF IN EYES: Rinse cautiously with water for several minutes.	
Storage:	Store in a well-ventilated place. Keep container tightly closed.	
Container Labeling:	While Calgon Carbon Corporation has added GHS classification information to MSDS documents, changes to container labeling has not been implemented. Changes to container labels will be made in accordance to the requirements to be defined by OSHA's revision to the Hazard Communication Standard once final adoption of rule is approved and released.	

SECTION III – COMPOSITION /INFORMATION ON INGREDIENTS

Chemical Identity (% by Wt)	Common Name (Ingredient / Component)	CAS No	Impurities
100	Activated Carbon (Coal based)	7440-44-0	None

SECTION IV – FIRST-AID MEASURES

Route of Exposure	
Inhalation	Dust may cause mild irritation to the upper respiratory tract.
Skin	Dust may cause mild irritation, possibly reddening.
Eyes	Dust may cause mild irritation, possibly reddening.
Ingestion	Dust may cause mild irritation to digestive track resulting in nausea or diarrhea.
Signs/Symptoms of Exposure	Dust may cause irritation and redness of eyes, irritation of skin and respiratory system. The effects of long-term, low-level exposures to this product have not been determined.
Emergency and First Aid	For eye contact: Immediately flush with copious amounts of

Procedures	<p>water for at least 15 minutes, lifting both the upper and lower lids occasionally; seek medical attention.</p> <p>For skin contact: Wash with soap and water; seek medical attention.</p> <p>For inhalation: Remove to fresh air and rest as needed; seek medical attention for any breathing difficulty.</p> <p>For ingestion: Drink plenty of water; seek medical attention.</p>
Medical Conditions Generally Aggravated by Exposure	People with pre-existing skin conditions or eye problems or impaired respiratory function may be more susceptible to the potential effects of the dust.

SECTION V – FIRE FIGHTING MEASURES

Suitable Extinguishing Media	Use an extinguishing media suitable for surrounding the fire.
Unsuitable Extinguishing Media	None known
Specific Hazards	<p>As with most organic solids, fire is possible at elevated temperatures or by contact with an ignition source. Activated carbon is difficult to ignite and tends to burn slowly (smolder) without producing smoke or flame.</p> <p>Carbon monoxide and carbon dioxide gas may be emitted upon combustion of material.</p> <p>Contact with strong oxidizers such as ozone or liquid oxygen may cause rapid combustion.</p>
Protective Equipment and Procedures	Wear NIOSH approved self-contained breathing apparatus suitable for the surrounding fire.

SECTION VI – ACCIDENTAL RELEASE MEASURES

Personal Precautions	Wear protective equipment, keep unnecessary personnel away, and ventilate area of spill.
Environmental Precautions	The carbon is not soluble, but can cause a particulate emission if discharged to waterways; therefore, dike all entrances to sewers and drains to avoid introducing the material into the waterways.
Containment & Clean-up	<p>Dike all entrances to sewers and drains. Vacuum or shovel spilled material and place in closed container for disposal.</p> <p>Remove product to appropriate storage area until it can be properly disposed of in accordance with local, state and federal regulations. Avoid dust formation.</p> <p>See section XIII.</p>
Other Information	NA

SECTION VII – HANDLING AND STORAGE

Precautions for Safe Handling	Avoid prolonged contact with eyes and skin. Keep away from ignition sources. Use in well ventilated areas. Protect containers from physical damage. Wash hands after handling.
Conditions for Safe Storage	Store in cool, dry, ventilated area and in closed containers. Keep away from oxidizers, heat or flames. Store away from ignition sources.

SECTION VIII – EXPOSURE CONTROLS/PERSONAL PROTECTION

Component	OSHA PEL	ACGIH TLV	Other Limits
Activated Carbon	Data not available	Data not available	
Exposure Guidelines	Wet activated carbon removes oxygen from air posing a hazard to workers in enclosed or confined space. Before entering such an area, sample the air to assure sufficient oxygen supply. Use work procedures for low oxygen levels, observing all local, state and federal regulations.		
Engineering Controls	<p>Exhaust ventilation should be designed to prevent accumulation and recirculation in the workplace and safely remove carbon black from the air.</p> <p>Note: Wet activated carbon removes oxygen from air causing a severe hazard to workers in enclosed or confined space.</p> <p>If risk of overexposure exists, wear an approved respirator. Provide adequate ventilation in warehouse or closed storage area.</p>		
Personal Protective Equipment	Use of NIOSH approved particulate filter is recommended if dust is generated in handling. The usual precautionary measures for handling chemicals should be followed, i.e. gloves, safety glasses w/side shields or goggles, long sleeve shirt or lab coat, dust respirator if dusty and/or other protective clothing/equipment as determined appropriate.		
General Hygiene	The usual precautionary measures for handling chemicals should be followed: i.e. Keep away from food and beverage; remove contaminated clothing immediately; wash hands before breaks or eating; avoid contact with eyes and skin.		

SECTION IX – PHYSICAL AND CHEMICAL PROPERTIES

Physical State (Appearance)		Black granular or powder material	
Color	Black	Molecular Weight	NA
Odor	None	Odor Threshold	None
pH Value	NA	Vapor Pressure	0

Melting Point	NA	Vapor Density	Solid
Freezing Point	NA	Relative Density	0.4 to 0.7
Initial Boiling Point	NA	Solubility	Not Soluble
Flashpoint	NA	Partition Coefficient	NA
Evaporation Rate	NA	Auto Ignition Temp.	>220 ⁰ C
Flammability	>220 ⁰ C	Decomp. Temp.	NA
UEL	NA	Viscosity	NA
LEL	NA		

SECTION X – STABILITY AND REACTIVITY

CHEMICAL STABILITY	UNSTABLE		CONDITIONS TO AVOID: None
	STABLE	XX	
POSSIBILITY OF HAZARDOUS REACTION	MAY OCCUR		CONDITIONS TO AVOID: None
	WILL NOT OCCUR	XX	
Caution: High concentrations of organics in air will cause temperature rise due to heat of adsorption. At very high concentration levels this may result in a thermal excursion, referred to as a bed fire. High concentrations of Ketones and Aldehydes may cause a bed temperature rise due to adsorption and oxidation.			
Materials to Avoid			Alkali metals and strong oxidizers such as ozone, oxygen, permanganate, chlorine.
Hazardous Decomposition Products			Carbon monoxide and carbon dioxide gas may be generated during combustion of this material.

SECTION XI – TOXICOLOGICAL INFORMATION

Acute Effects		
Toxicity Studies	Oral LD ₅₀	Not determined on the finished product.
	Dermal LD ₅₀	Not determined on the finished product.
Inhalation	See section IV.	
Ingestion	See section IV.	
Eye Irritation	See section IV.	
Skin Irritation	See section IV.	
Sensitization	Not determined on the finished product.	
Target Organ (s) or System		Eyes, skin and upper respiratory system.
Signs and Symptoms of Exposure		Irritation and redness of eyes, irritation of skin and respiratory system may result from exposure to carbon dust.
		See Sections III and IV.
Chronic Effects		
Carcinogenicity		Not determined on the finished product.

Mutagenicity	Not determined on the finished product.
Reproductive Effects	Not determined on the finished product.
Developmental Factors	Not determined on the finished product.

SECTION XII – ECOLOGICAL INFORMATION

Ecotoxicity	Not determined on the finished product.
Persistence/Degradability	Not determined on the finished product.
Bioaccumulation/Accumulation	Not determined on the finished product.
Mobility in Environmental Media	Not determined on the finished product.
Other Adverse Effects	Not determined on the finished product.

SECTION XIII – DISPOSAL CONSIDERATIONS

Vacuum or shovel material into a closed container. Storage and disposal should be in accordance with applicable local, state and federal laws and regulations. Local regulations may be more stringent than state or federal requirements. Activated Carbon is an adsorbent media; hazard classification is generally determined by the adsorbate that the carbon has picked up. Consult with the US EPA Guidelines listed in 40 CFR Part 261.3 for the classifications of hazardous waste prior to disposal.

SECTION XIV – TRANSPORT INFORMATION

This information as presented below only applies to the material as shipped. The identification based on characteristic(s) or listing may not apply if the material has been used or otherwise contaminated. It is the responsibility of the waste generator to determine the toxicity and physical properties of the material generated to determine the proper waste identification and disposal methods in compliance with applicable regulations.

Land	DOT Regulations	UN/NA Identification Number:	FILTRASORB 300 ARNone on finished product
		UN- Proper Shipping Name:	Not Regulated
		Transport Hazard Class:	None on finished product; see Note 1 below
		Packing Group:	None on finished product
		Marine Pollutant:	None on finished product
	Canadian WHMIS	Hazard Class:	None on finished product
Water	IMO / IMDG	UN/NA Identification Number:	FILTRASORB 300 ARNone on finished product
		UN- Proper Shipping Name:	Not Regulated
		Transport Hazard Class:	None on finished product

		Packing Group:	None on finished product
		Marine Pollutant:	None on finished product
Air	ICAO / IATA	UN/NA Identification Number:	FILTRASORB 300 ARNone on finished product
		UN- Proper Shipping Name:	Not Regulated
		Transport Hazard Class:	None on finished product
		Packing Group:	None on finished product
		Marine Pollutant:	None on finished product
		Information reported for product/size: 0.5 Kg	
Note 1: Under the UN classification for activated carbon, all activated carbons have been identified as a class 4.2 product. However, This product has been tested according to the <u>United Nations Transport of Dangerous Goods</u> test protocol for a “self-heating substance” (<u>United Nations Transportation of Dangerous Goods, Manual of Tests and Criteria, Part III, Section 33.3.1.6 - Test N.4 - Test Method for Self Heating Substances</u>) and it has been specifically determined that this product does not meet the definition of a self heating substance (class 4.2) or any other hazard class, and therefore should not be listed as a hazardous material. This information is applicable only for the Activated Carbon Product identified in this document.			

SECTION XV – REGULATORY INFORMATION

SARA Title III 302	Product is not subject to SARA Title III, section 302 regulation.	
SARA Title III 313	Product is not subject to SARA Title III, section 313 regulation.	
TSCA	Product is listed.	
California Proposition 65	Product is not listed.	
Canadian Classification	WHMIS	Product is listed.
	DSL #	Product is listed.
EEC Council Directives relating to the classification, packaging, and labeling of dangerous substances and preparations.		
Risk and Safety Phrases	R36: Irritating to the eyes. R37: Irritating to the respiratory system. R38: Irritating to the skin.	
Carbon, activated (CAS: 7440-44-0) is found on the following regulatory lists:	Canada - British Columbia Occupational Exposure Limits Canada - Yukon Permissible Concentrations for Airborne Contaminant Substances Canada Domestic Substances List (DSL) International Air Transport Association (IATA) Dangerous Goods Regulations OECD Representative List of High Production Volume (HPV) Chemicals US - Hawaii Air Contaminant Limits US - Idaho - Toxic and Hazardous Substances - Mineral Dust US - Minnesota Hazardous Substance List US - Minnesota Permissible Exposure Limits (PELs) US - Rhode Island Hazardous Substance List US - Vermont Permissible Exposure Limits Table Z-1-A Final Rule	

	Limits for Air Contaminants US - Washington Permissible exposure limits of air contaminants US DOE Temporary Emergency Exposure Limits (TEELs) US EPA High Production Volume Program Chemical List US FDA CFSAN Color Additive Status List 4 US FDA CFSAN Color Additive Status List 6
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SECTION XVI – OTHER INFORMATION

Intended Use	The material is generally used for treatment of gases and liquids.
The information contained in this document applies to this specific material as supplied. It may not be valid for this material if it is used in combination with any other materials. It is the user's responsibility to determine the suitability and completeness of this information for their particular use.	
While the information and recommendations set forth herein are believed to be accurate as of the date hereof, Calgon Carbon Corporation makes no warranty with respect to same and disclaims all liability for reliance there on.	

Legend:


ACGIH	- American Conference of Governmental Industrial Hygienists
ANSI	- American National Standards Institute
CAS #	- Chemical Abstracts Service Registry Number
CFR	- Code of Federal Regulations
CFSAN	- Center for Food Safety and Applied Nutrition
DOE	- Department of Energy
DOT	- Department of Transportation
DSL	- Domestic Substances List
EEC	- European Economic Community
EPA	- Environmental Protection Agency
FDA	- Food and Drug Administration
GHS	- Globally Harmonized System (of Classification and Labeling of Chemicals)
HMIS	- Hazardous Material Information System
IATA	- International Air Transportation Association
ICAO	- International Civil Aviation Organization
IMO	- International Maritime Organization
IMDG	- International Maritime Dangerous Goods
LD ₅₀	- Lethal Dose expected to kill 50% of a group of test animals
LEL	- Lower Explosive Limit
NA	- Not Applicable
NFPA	- National Fire Protection Association
NIOSH	- National Institute for Occupational Safety and Health
OECD	- Organization for Economic Cooperation and Development
OSHA	- Occupational Safety and Health Association
PEL	- Permissible Exposure Limit
SARA	- Superfund Amendments and Reauthorization Act
TLV	- Threshold Limit Value
TSCA	- Toxic Substances Control Act
UEL	- Upper Explosive Limit
WHMIS	- Workplace Hazardous Material Information System

* * *END OF MATERIAL SAFETY DATA SHEET * * *



SECTION 9

SPECIFICATIONS AND CATALOG CUTS

	CARBON STEEL PIPE MATERIAL SPECIFICATION	SPEC NO:
	CARBON STEEL PIPE WITH STEEL FITTINGS	C02

SAP PART NUMBER:

CCC DRAWING NUMBER:

MATERIAL:

Carbon steel pipe with steel fittings

RATING:

125 PSIG @ 350 DEG. F, 200 PSIG @ 150 DEG. F, Includes corrosion allowance of 0.050" min.

CONSTRUCTION:

Screwed for 1 1/2" and smaller, welded and/or flanged for 2" and larger.

PIPE:

Carbon steel, ASTM A53, Grade B: Threaded, schedule 80, seamless, 1 1/2" and smaller, plain end, schedule 40, seamless, 2" to 10", Plain end, 3/8" wall, seamless, 12" and above.

FITTINGS:

3000 lb ANSI B16.11, forged steel, threaded ends, 1 1/2" and smaller. Schedule 40, ANSI B16.9, ASTM A234, Grade WPB, carbon steel, butt welding ends, 2"-12". 3/8" wall, ANSI B16.9, ASTM A234, Grade WPB, carbon steel, butt welding ends, 14" to 24", or 125# flanged cast iron elbows and tees, ASTM A126, Class B with 125# ANSI B16.1 drilling with dimensions per ANSI A21.10 (AWWA C110). Location of tapped holes for drains shall be in accordance with ANSI B16.1. Use thread-o-lets on branch connections 1-1/2" and smaller, use stub-in or reducing tee connections for 2" and above.

UNIONS:

3000 lb forged steel, ASTM A105, Grade 2, integral steel seat, ground joint, threaded ends.


FLANGES:

150 lb ANSI B16.5, ASTM A105 forged carbon steel, slip-on, weld neck, or MSS lap joint/stub end for 2" and larger, threaded 1 1/2" and smaller. Where bolting to flat face cast iron flanges, flanges shall be furnished with a flat face. Others shall be raised face.

Issue Date: 12/3/03

Revision Date: 03/25/2008

Approved by Joseph P. McMahon on 03/25/2008

	CARBON STEEL PIPE MATERIAL SPECIFICATION	SPEC NO:
	GALVANIZED CARBON STEEL PIPE	C13

SAP PART NUMBER:

CCC DRAWING NUMBER:

MATERIAL: Galvanized carbon steel pipe with galvanized iron or steel fittings.

RATING: 275 PSIG @ -20 to 150 DEG. F
215 PSIG @ 350 DEG. F Includes corrosion allowance of 0.050" minimum.

CONSTRUCTION: Screwed 3" and smaller
No bending permitted

PIPE: Galvanized carbon steel, ASTM A53:
Threaded, schedule 40, butt welded seam 2" and smaller.
Threaded schedule 40, butt welded seam or seamless, 2 1/2" and 3".

FITTINGS: 150 lb., ANSI B16.3, ASTM A197, galvanized malleable iron, banded, threaded ends.

UNIONS: 150 LB., ASTM A197, galvanized malleable iron, integral iron seat, ground joint, threaded ends.

FLANGES: 150 lb., ANSI B16.5, ASTM A105, Grade 1, galvanized forged carbon steel, threaded.


Where bolting to flat face cast iron flanges, steel flanges shall be furnished with a flat face. Others shall be raised face

BOLTING: See attached Fastener Specification F03.

GASKETS: See attached Gasket Specification G02.

Issue Date: 12/01/89 Revision Date: 04/10/92

Approved by Gerald Kirner on 11/09/2005

	FASTENER MATERIAL SPECIFICATION	SPEC NO:
		F03

SAP PART NUMBER:

CCC DRAWING NUMBER:

MATERIAL:

Hex Bolt, low or medium carbon steel, ASTM A307 Grade B.

1/4" through 4" Proof load 55,000 psi.


1/4" through 4" Tensile strength: 60,000 psi minimum, 100,000 psi maximum.

Zinc plated.

Threads to be UNC unless specified UNF bolts to include (1) heavy hex nut, ASTM A563, Grade A.

Issue Date: 01/01/89 Revision Date: 07/16/2001

Approved by Matthew R. McGowan on 07/16/2001

	FASTENER MATERIAL SPECIFICATION	SPEC NO:
		F20


SAP PART NUMBER:

CCC DRAWING NUMBER:

MATERIAL: Stud bolts, alloy steel, ANSI B18.2, ASTM A193, Grade B7, with two heavy semi-finished hexagon 2H nuts per bolt, Zinc plated.

Issue Date: 07/10/91 Revision Date: 05/28/92

Approved by Matthew R. McGowan on 07/12/2001

	GASKET MATERIAL SPECIFICATION	SPEC NO:
	1/8" EPDM RUBBER (FDA)	G-46

SAP PART NUMBER:

CCC DRAWING NUMBER:

MATERIAL: EPDM, Color: Off-White, 1/8" thick.

RATING: Durometer (Shore A +/- 5): 60

MANUFACTURER: Garlock or equal.

SIZES: Pipe gasket flange dimension per ANSI B16.21

MODELS: Garlock- 8316 or equal.

SPECIFICATIONS: Meets FDA Requirements


SERVICE CONDITIONS:

Temperature: -40 thru 300 degrees F. Pressure: 250 psig

Issue Date: 03/12/2008

Revision Date: 03/25/2008

Approved by Joseph P. McMahon on 03/26/2008

	PLASTIC PIPE MATERIAL SPECIFICATION	SPEC NO:
	PVC PLASTIC PIPE WITH PVC PLASTIC FITTINGS	P06

SAP PART NUMBER:

CCC DRAWING NUMBER:

MATERIAL: PVC plastic pipe with PVC plastic fittings.

RATING: 150 PSIG @ 75 DEG. F.

CONSTRUCTION: Socket Type PVC for 2" and larger.
And/or Threaded for up to 2"

PIPE: PVC Type 1, Grade 1, ASTM D1784, Schedule 80, Socket Type ends 2"
and larger.
And/or Threaded for up to 2"

FITTINGS: PVC Type 1, Grade 1, ASTM D2467, Schedule 80, socket Type ends, 2"
and larger.
And/or Threaded, ASTM D2464 for up to 2"

FLANGES: 150 lb., ANSI B16.5, PVC Type 1, Grade 1, socket Type 2" and larger.
And/or Threaded for up to 2"


ORIFICE FLANGES: Instrument item.

BOLTING: See attached Fastener Specification F03.

GASKETS: See attached Gasket Specification G04.

Issue Date: 12/01/89 Revision Date: 01/01/97

Approved by Joseph P. McMahon on 07/24/98

	STAINLESS STEEL PIPE MATERIAL SPECIFICATION	SPEC NO:
	INSTRUMENT PIPING, HEAT TRACING, ETC.	S06

SAP PART NUMBER:

CCC DRAWING NUMBER:

MATERIAL: Stainless steel tubing and flareless compression fittings, and stainless steel pipe and fittings.

RATING: 150 PSIG @ 365 DEG. F.
300 PSIG @ 100 DEG. F.

CONSTRUCTION: For tubing systems 1" and smaller. Pipe and screwed pipe fittings to be used for take-off connections on larger pipe, manifolding, connections to screwed instruments, equipment, etc. Tubing to be used for all other piping in the system.

PIPE NIPPLES: ASTM A312, Type 316, seamless, Schedule 80S, ANSI B36.19, annealed and pickled.

PIPE FITTINGS: Type 316 stainless steel screwed fittings, dimensions per ANSI B16.3, forged, wrought or cast material rated 150 lb. Camco Fittings Co., or equal.


TUBING: Type 316 stainless steel seamless tubing, 0.035" wall thickness, annealed and pickled, hardness 70-74 Rockwell "B", 1/4 O.D.

TUBE FITTINGS: Type 316 stainless steel, flareless compression fittings, Crawford Fitting Company "Swagelok", or equal.

Issue Date: 01/01/89

Revision Date:

Approved by Joseph P. McMahon on 07/24/98

	STAINLESS STEEL PIPE MATERIAL SPECIFICATION	SPEC NO:
	TYPE 316 STAINLESS STEEL PIPE AND FITTINGS	S15

SAP PART NUMBER:

CCC DRAWING NUMBER:

MATERIAL: Type 316 stainless steel pipe and fittings.

RATING: 150 PSIG @ 365 DEG. F.
300 PSIG @ 100 DEG.F.

CONSTRUCTION: Screwed for 3" and smaller

PIPE: Threaded, Schedule 40S, ASTM A312, Type316, welded, ANSI B36.19,
annealed and pickled.

FITTINGS: Type 316 stainless steel screwed fittings, general dimensions to conform
to ANSI B16.3 for malleable iron screwed fittings. Forged, wrought or cast material rated 150 Lb. @ 365
DEG.F., Camco Fittings Co., or equal.

FLANGES: Type 316 stainless steel, threaded, MSS-SP-51, 150 Lb. flat face,
serrated finish.


ORIFICE FLANGES: Instrument Item.

BOLTING: See attached Fastener Specification F03.

GASKETS: See attached Gasket Specification G02.

Issue Date: 12/01/89 Revision Date: 06/20/2001

Approved by Gerald Kirner on 06/21/2001

	STAINLESS STEEL PIPE MATERIAL SPECIFICATION	SPEC NO:
	TYPE 304L STAINLESS STEEL	S25

SAP PART NUMBER:

CCC DRAWING NUMBER:

MATERIAL: Type 304L stainless steel.

RATING: 150 PSIG @ 500 DEG. F.

CONSTRUCTION: Flanged and welded for 2" and larger.
Threaded for 1 1/2" and smaller.

PIPE: Plain end, stainless steel pipe ASTM A-312, Grade TP 304L, welded, annealed and pickled. Pipe dimensions to conform with Schedule 10S, ANSI B36.19. For 1 1/2" and smaller, use SCH. 40.

FITTINGS: ASTM A-403, Grade WP 304L stainless steel, ANSI B16.9 butt weld, Schedule 10S ANSI wall thickness, for 2" and larger. For 1 1/2" and smaller use screwed fittings, Type 304L, dimensions per ANSI B16.3, forged, wrought or cast material rated 150 lb.

FLANGES: ASTM A-182 Grade F304 forged stainless steel, 150# ANSI B16.5, raised face slip-on or weld neck type. Where bolting to flat face flanges on instruments or equipment, flanges shall be furnished with a flat face.

ORIFICE FLANGES: Instrument Item.


BOLTING: See attached Fastener Specification F03.

GASKETS: See attached Gasket Specification G10 for 1/16", or G11 for 1/8".

Issue Date: 03/28/95

Revision Date:

Approved by Joseph P. McMahon on 07/24/98

	BUTTERFLY VALVES MATERIAL SPECIFICATION	SPEC NO:
	ONE-PIECE CAST IRON BUTTERFLY VALVE	3.44

SAP PART NUMBER:

CCC DRAWING NUMBER:

MATERIAL: One-piece cast iron wafer style body, epdm or buna-n seat material, gasket type seal, torque plug connection, 416 stainless steel stem (or of greater corrosion resistance), bronze or aluminum bronze disc material, bronze upper and lower bushings. Lever operator for valve sizes 2" through 6", weatherproof worm gear wheel operator for sizes 8" through 12" (handwheel diameter shall not exceed 9"). Valves shall comply with section 5: Inspection Testing and Rejection of AWWA specification C-504-87 with one exception; test pressure shall be 200 psig.

RATING: 200 psig @ 180 Deg. F.

CONSTRUCTION: Shaft: 1 piece, through shaft construction.

MANUFACTURER: Centerline, Pratt, Xomox, Crane, Apollo, Sure-Seal, Flow Line or equal.

SIZES: 2" through 12"

MODELS: Centerline Series 200, Pratt Series 396, Xomox Series 700, Crane Series 42, Apollo Series 141, Sure-Seal Series 600, Flow Line Series 70 or equal.

Issue Date: 10/29/92

Revision Date: 08/13/2009

Approved by Joseph P. McMahon on 08/13/2009

CCC SPEC 3.44

Flow Line 70/71

*Wafer & Lug Style
Sizes 2" - 12"*



Flow Line™
Valve and Controls

Cartridge Seated
Butterfly Valves

Body

- One piece ribbed wafer and lugged body is Polyester coated as standard for a superior appearance and excellent resistance to external corrosion.
- Heavy duty ISO 5211 Top plate is slotted for ease of actuation and engineered to accept direct mounting of operators.
- Standard extended neck provides full clearance for 2" of insulation.

Disc

- Streamlined design offers higher Cv and lower pressure drop.

Shaft

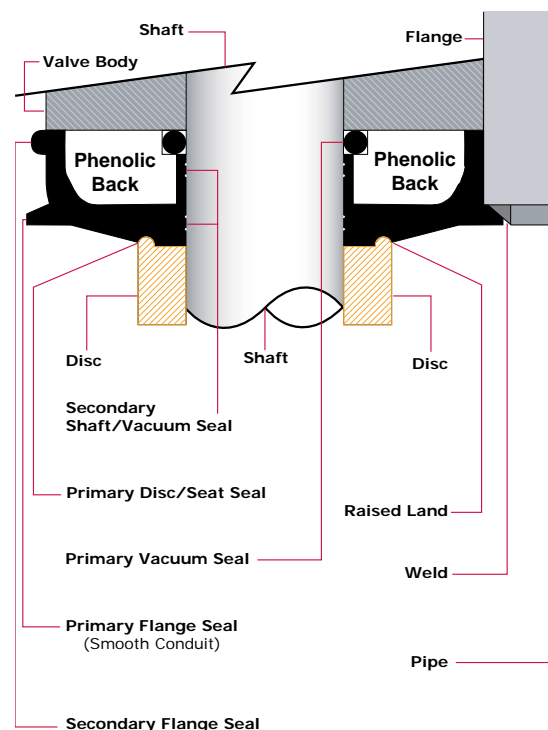
- Triple shaft seals support the primary seal on machined radius of the disc. Our triple shaft seals ensure a dry stem design.
- Two secondary shaft seals are located inside the seat shaft holes and an environmental shaft seal eliminates contaminants from entering the shaft bore.
- Two self lubricated bronze bearings offer consistent torque valves and eliminate side loading.

Seat and Flange Seals

- Field replaceable, phenolic bonded cartridge seat provides no movement of the elastomer which is a common failure point of many resilient flexible seat designs.
- Torque fluctuation is eliminated by our phenolic bonded elastomer seats.
- Our dual purpose primary flange seal is widened offering additional compression of the elastomer against various flanges resulting in a positive seal.
- This resulting primary flange seal provides a smooth flow conduit for media and prevents build up in crevices created by traditional seat designs.
- Molded secondary flange seals assure no leakage when used with weld neck, slip on, and threaded flanges and eliminates the need for gaskets or O-rings.

Disc/Shaft Connection

- A high strength Double D drive ensures a positive shaft to disc connection.
- Disc floats inside the seat for positive sealing and extended seat life.
- No pins or bolts are exposed to flow.
- Offset shaft retainers mechanically retain the shaft in the body ensuring a blow out proof design.



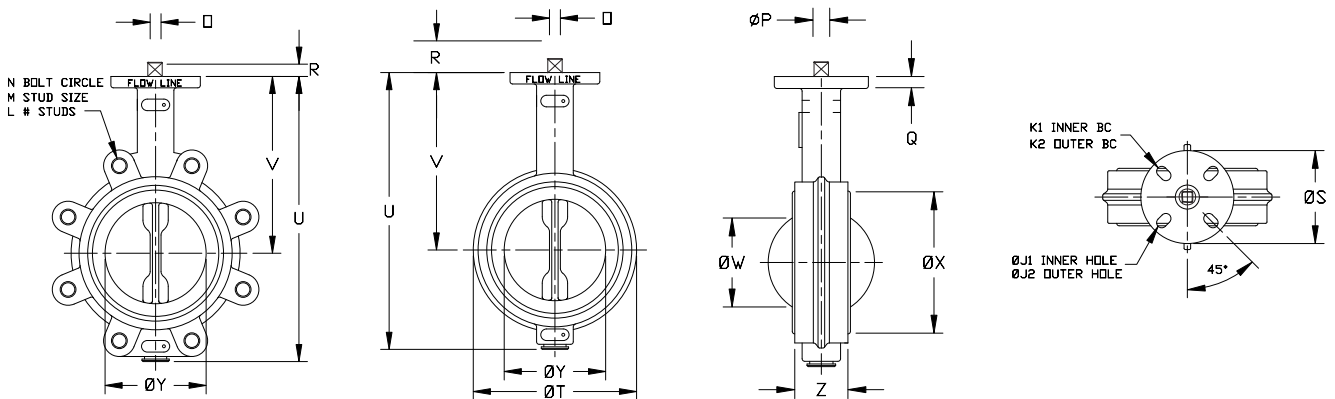
Shaft Sealing Method

- Disc shaft holes surrounded by a 360° machined radius are in constant contact with the flatted area of the seat.
- This design is far superior to resilient flexible seat designs that depend on the "squeeze" effect of the disc and seat interference which allows leakage behind the seat and up the shaft.
- The Flow Line shaft seal is achieved through a continuous pressure exerted from the flatted area of the seat to the machined radius of the disc.
- This sealing mechanism is further enhanced by forces exerted on the seat and shaft providing a secondary seal resulting in media free disc, shaft and seat connection.

Applicable Standards

- ANSI B16.1 Conforms to ANSI Class 125 flange drilling.
- ANSI B16.5 Conforms to ANSI 150 flange drilling.
- ANSI B16.42 Conforms to ANSI Class 150 flange drilling, body wall thickness and pressure-temperature ratings.
- ANSI B16.104 Exceeds Class VI shutoff requirements.
- API 609 Butterfly Valve Category A.
- AWWA C504 Diameter of stainless steel shaft exceeds AWWA Class 75B standard. Body wall thickness exceeds the AWWA Class 150B standard for butterfly valves.
- MSS SP-25 Markings and identification conform to the requirements.
- MSS SP-67 Butterfly Valves
- ISO 5211 Actuator Mounting
- USCG Category "A" Title 46, CFR, Part 56

DIMENSIONS



Valve Size	Z	Y	X	W	V	U	T	S	R	Q	P	O	Lug Drilling			Top Plate Drilling					Weight (lb)
													N	M	L	K1	K2	#holes	J1	J2	
2	1.74	2.25	2.65	1.46	5.62	8.44	4.12	4.00	0.827	.44	.551	0.551	4.75	5/8-11	4	2.76	3.25	4	.39	.41	8
2-1/2	1.86	2.81	3.15	2.14	6.12	9.19	4.88	4.00	0.827	.44	.551	0.551	5.50	5/8-11	4	2.76	3.25	4	.39	.41	10
3	1.86	3.31	3.78	2.74	6.38	9.69	5.38	4.00	0.827	.44	.551	0.551	6.00	5/8-11	4	2.76	3.25	4	.39	.41	11
4	2.11	4.19	4.78	3.60	7.12	11.00	6.88	4.00	0.827	.44	.551	0.551	7.50	5/8-11	8	2.76	3.25	4	.39	.41	17
5	2.24	5.06	5.84	4.58	7.75	12.12	7.75	4.00	1.063	.44	.670	.670	8.50	3/4-10	8	2.76	3.25	4	.39	.41	23
6	2.24	6.06	7.03	5.62	8.25	13.25	8.75	4.00	1.063	.44	.670	.670	9.50	3/4-10	8	2.76	3.25	4	.39	.41	29
8	2.54	7.94	8.96	7.43	9.44	15.56	11.00	6.00	1.063	.56	.866	0.866	11.75	3/4-10	8	4.02	5.00	4	.53	.53	44
10	2.74	10.00	11.09	9.38	11.25	18.69	13.38	6.00	1.063	.56	.866	0.866	14.25	7/8-9	12	4.02	5.00	4	.53	.53	66
12	3.24	11.94	13.09	11.35	12.19	21.69	16.12	6.00	1.063	.56	.866	0.866	17.00	7/8-9	12	4.02	5.00	4	.53	.53	99

CLASS II TORQUES (Inch-Pounds)

Shutoff Pressure	2"	2 1/2"	3"	4"	5"	6"	8"	10"	12"
50 PSI SHUTOFF	66	96	150	225	350	450	750	1325	2250
75 PSI SHUTOFF	98	141	237	261	504	651	1050	1778	2990
100 PSI SHUTOFF	103	148	249	343	531	685	1105	1872	3147
125 PSI SHUTOFF	107	155	260	376	553	714	1151	1950	3279
150 PSI SHUTOFF	110	158	265	384	564	728	1275	1989	3345
175 PSI SHUTOFF	121	175	283	417	632	814	1337	2320	3923
200 PSI SHUTOFF	132	192	300	450	700	900	1500	2650	4500
250 PSI SHUTOFF	145	211	318	486	770	990	1695	2995	5085
285 PSI SHUTOFF	160	232	337	528	847	1089	1915	3384	5746

Cv VALUES

Valve Size	10°	20°	30°	40°	50°	60°	70°	80°	90°
2	2	3.5	8	21	40	87	108	141	170
2-1/2	3	5	11	27	52	121	172	253	332
3	8	16	23	50	92	147	224	420	473
4	17	33	57	110	182	297	462	773	913
5	47	94	143	231	380	578	908	1485	1650
6	91	182	248	396	627	902	1386	2063	2178
8	116	231	330	528	858	1452	2508	4158	4257
10	223	446	633	935	1320	2090	3630	6710	7095
12	303	605	825	1320	2063	3135	5528	10230	10780

Notes:

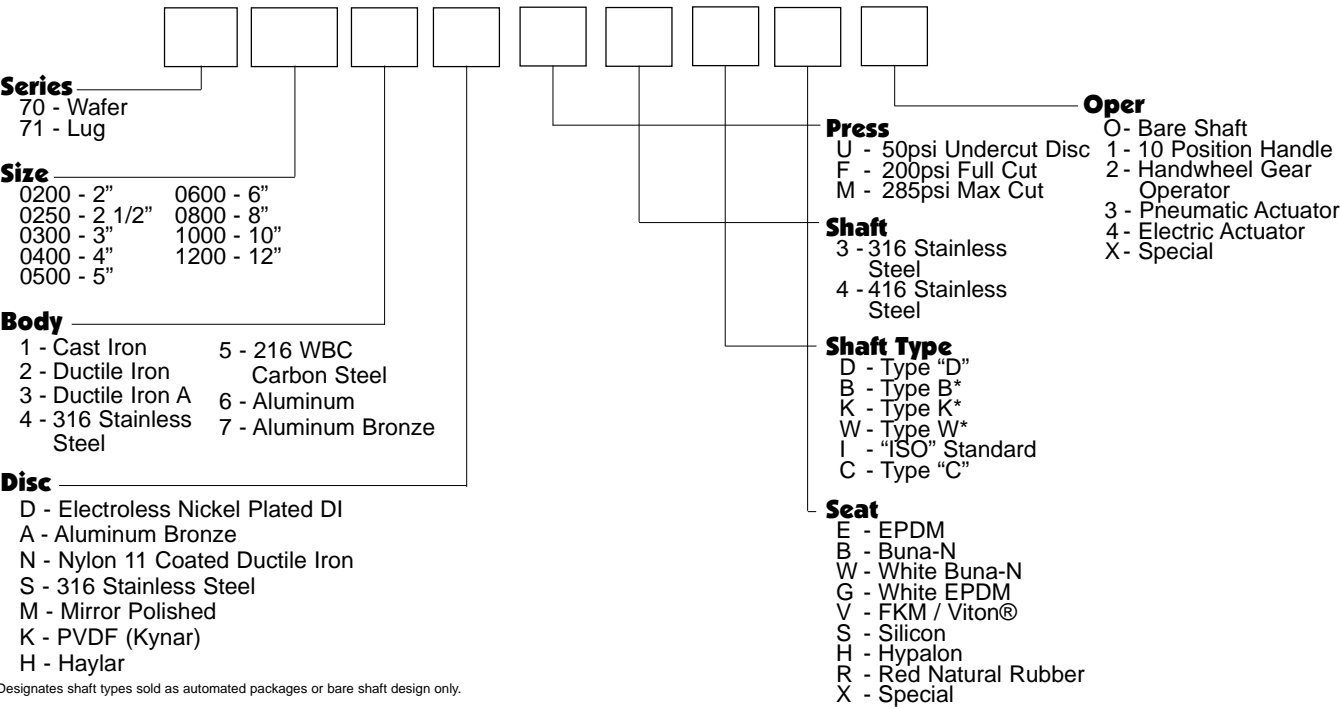
1. This chart to be used as a guide only.
2. These torque ratings do not apply to every possible service criteria, which may affect seating and unseating torque.
3. Torque values are applicable to Flow Line Series 70/71.
4. Do not apply a safety factor to the above torque values when sizing actuators.
5. Dynamic Torque should always be a consideration when sizing valves with high differential pressures.
6. For 3 way tee assemblies multiply the above torques by 1.5.

Class II

- Valve to be operated a minimum of once a month.
- Temperature well within resilient seat limits.
- Line media is a self lubricating. (Aqueous liquids)
- Minor chemical attacks on seat.
- Disc corrosion and media deposits to be mild.

SPECIFICATIONS

HOW TO ORDER



* Designates shaft types sold as automated packages or bare shaft design only.

Recommended Specifications

- Polyester coated ribbed wafer or lug bodies to provide extended necks for insulation and be able to install between ANSI 125/150 flanges. Lug design in sizes 2" - 12" to be fully rated for dead end service without any modification.
- Streamlined disc design with no pins or screws in the flow path and designed for high Cv and lower pressure drop.
- Upper and lower shaft design to utilize triple shaft seals as standard.
- Blow out proof design utilizing a Double D drive for a positive disc/shaft connection.
- Pressure responsive 360° sealing design will use constant pressure between machined radius on disc and flatted area of the seat.
- Valve to be Flow Line Series 70 wafer or Flow Line Series 71 lug design.

Components			
Qty	Description	Qty	Description
1	Body	2	Shaft Retainers
1	Disc	1	Bearing Retainer
1	Upper Shaft	1	Environmental Shaft Seal
1	Lower Shaft	2	Secondary Shaft Seals
1	Seat	1	Thrust Bearing
		1	Inboard Bearing

Materials of Construction 2" - 12"

- Body

 - Cast Steel ASTM A-216 WCB
 - 316 Stainless Steel ASTM A-351 CF8M
 - Cast Iron ASTM A-126 Class B
 - Ductile Iron ASTM A-536 (65-45-12)
 - Ductile Iron ASTM A-395 (60-40-18)
- Disc

 - Electroless Nickel Plated Ductile Iron ASTM A-536 (65-45-12)
 - Aluminum Bronze ASTM B-148 (954)
 - Nylon 11 Coated Ductile Iron ASTM A-536 Grade (65-45-12)
 - 316 Stainless Steel ASTM A-351 (CF8M)
- Stem


 - 316 Stainless Steel ASTM A-276 Type 316
 - 416 Stainless Steel ASTM A-582 Type 416
- Seat

■ EPDM - FDA Food Grade	-30 to + 275
■ Buna-N - FDA Food Grade	0 to +180
■ White Buna-N - FDA Food Grade	0 to + 180
■ Viton® - FDA Food Grade	0 to + 375
■ Silicon - FDA Food Grade	-80 to + 450
■ Hypalon	0 to + 180
■ Red Natural Rubber	0 to + 150

Viton® is a registered trademark of the E.I. DuPont De Nemours Company. FKM is the ASTM D1418 designation for Fluorinated Hydrocarbon elastomers such as Viton® (DuPont) and Fluorel® (3M).

FEATURES

- Slotted ISO 5211 top plate and shaft for flexibility of direct mounting options
- Environmental shaft seal to keep contaminants from entering shaft bore
- Offset shaft retainers mechanically retain the shaft ensuring a blow out proof design
- One piece ribbed Polyester coated body with extended neck
- Streamlined disc with no pins or screws in flow path
- Primary seal provides a smooth flow conduit and prevents media buildup in crevices normally found with traditional designs
- Independent seals provide full vacuum rating



- High strength upper and lower shafts with triple shaft seals
- Two self lubricated bronze bearings to eliminate side loading
- Double D Drive for a positive disc/shaft connection with no pins or bolts exposed to flow
- Proven pressure responsive 360° sealing method uses constant pressure between machined radius on disc and flatted area of the seat that eliminates the "squeeze" of the interference seat design our competition relies on
- Phenolic bonded cartridge seat with primary and secondary seals provide no movement of the elastomer
- Two secondary shaft seals located inside the seat shaft holes

The **Series 70 wafer** style and **Series 71 lug** style are heavy duty cartridge seated butterfly valves compatible ANSI 125/150 weld neck, slip on, and threaded flange standards. 2" - 12" valves are fully rated to 200 psi, bi-directional, dead end service. Valves with undercut discs to 50 psi are also available through the size range. Valves with Max cut Disc to 285 psi are also available through size range. All Series 70/71 valves, regardless of the rated working pressure, are vacuum rated to 29.92" of Mercury Gauge (0 Micron).

COATINGS

Flow Line Series 70 and 71 butterfly valve bodies are Polyester coated as standard. Polyester is a significant upgrade to paint or two part epoxy coatings. Our standard Polyester coating offers outstanding protection against abrasion and corrosion. The Flow Line Polyester coating is not affected by outdoor exposure and maintains excellent resistance to UV rays.

TEST	RESULT
Salty Fog Test	No change in excess of 2000 hours
Outdoor Weathering (UV Rays)	No noticeable change in excess of 12 months
50% Sulfuric Acid Test	No change for 48 hours

INSTALLATION, MAINTENANCE AND ASSEMBLY

Handle Kit



The Flow Line Handle Kit is designed for manual on/off and throttling service for quarter turn, resilient seated butterfly valves ranging from 2" - 12". The Polyester coated ductile iron handle kit includes the handle assembly with a locking lever and bolt on plate notched at 10 degree increments. The notched plate also includes on/off stops to prevent over travel of the handle and can be used with a padlock as standard. Other available options include an Infinite Throttling Handle Kit, Memory Stop and a 2" Square Nut.

Handwheel Gear Operator



The Flow Line Handwheel Gear Operator is designed for manual on/off and throttling service for quarter turn butterfly valves ranging from 2" - 12". The handwheel gear operator is constructed with a heavy duty, Polyester coated ductile iron housing, is completely self lubricated and weatherproof. Along with the gear operator, it also includes a valve position indicator, ductile iron handwheel and mechanical travel stops for field adjustment. Other available options include a Chainwheel Kit, Padlock Kit and a 2" Square Nut.

Actuation



Series 21 spring return actuators are available throughout the size range.



Series 50 solenoid valves are available in 1/8", 1/4", and 1/2"NPT.



Series 52 and 53 limit switches provide local and remote valve position.



Series 55 and 56 positioners are available with either a 3-15 psi or 4-20 MADC signal.

Installation

To install, simply close the valve, position between the flanges and assemble the valve to the flanges with studs or cap screws. Do not use flange gaskets. Flow Line Series 70 and 71 butterfly valves can be installed with the disc closed. Before hand tightening the flange bolts, fully open the disc to ensure disc O.D. clearance with pipe I.D. Hand tighten the flange bolts and close the valve to check for valve disc and pipe clearance. If contact is made, reposition as necessary and tighten all flange bolts to proper torque specification.

Maintenance and Repair

No regular maintenance or lubrication is required. Factory assembly procedures provide adequate lubrication for the life of the valve. To replace any component, remove valve from the line by fully closing valve disc. Spread flanges, remove all bolts then remove valve from line.

Testing

All Flow Line Series 70 and 71 butterfly valves are bi-directionally tested to 130 percent of rated working pressure. Test certification is available upon request at time of order.

Flanges

ANSI 125/150 cast iron, steel, raised face, flat faced weld neck, slip on and threaded flanges are suitable for use with Flow Line butterfly valves. Please contact the factory for proposed installation with plastic flanges.

Warranty


All products manufactured by Flow Line Valve and Controls are warranted against defects in material and workmanship for a period of 2 years from date of installation.

All statements, technical information and recommendations in the bulletin are for general use only. Flow Line Valve and Controls is not responsible for suitability or compatibility of these products in relation to system requirements. Consult Flow Line Valve and Controls distributors or factory for the specific requirements and material selection for your intended application. Flow Line Valve and Controls reserves the right to change or modify product design or product without prior notice. Flow Line Valve and Controls is not responsible for editorial or pictorial errors within this literature.



110 Main Project Rd. Schriever, LA 70395
Phone (985) 414-6004 Fax (985) 414-6072
Toll 800-815-9226
www.flowlinevalves.com

Doc. No. FLBV1
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	BALL VALVES MATERIAL SPECIFICATION	SPEC NO:
	FORGED BRONZE, BRASS, OR BARSTOCK BRASS BODY REGULAR PORT BALL VALVE	4.03

SAP PART NUMBER:

CCC DRAWING NUMBER:

MATERIAL: Bronze or forged brass or barstock brass body regular port ball valve, blow-out proof stem, ball and seat retainer design to permit valve to be dead ended in either flow direction, chrome plated bronze or brass ball and stem, PTFE seats and seals (furnish glass fiber reinforced PTFE seats and graphited stem seal if required to meet pressure and temperature rating), wrench handle operated, threaded ends.

RATING: 500 PSIG @ 100 DEG. F.
150 PSIG @ 366 DEG. F.

MANUFACTURER: DuraValve / Siral or Equal.

SIZES: 1/4" thru 2"

MODELS: VRN5000 or Equal

GENERAL REQUIREMENTS:

PROPRIETARY AND CONFIDENTIAL

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Issue Date: 01/01/89 Revision Date: 08/14/2003

Approved by Gerald Kirner on 02/09/2006

"8901"**1/4"-3"**

BRASS BALL VALVE
TWO-PIECE, FULL-PORT
600 WOG / 150 SWP
THREADED ENDS*

MSS-SP110
 NSF61-8
 ASME A112.4.14

CSA
 C US
 ANSI Z 21.15-1997 Z CGA 9.1-M97
 3-88 IAS, CR91-002
 ASME 16.44-2002
 CAN/CGA-3.16-M88

UL US
 UL 125
 UL 842
 Subject 258

FM
 APPROVED
 1140

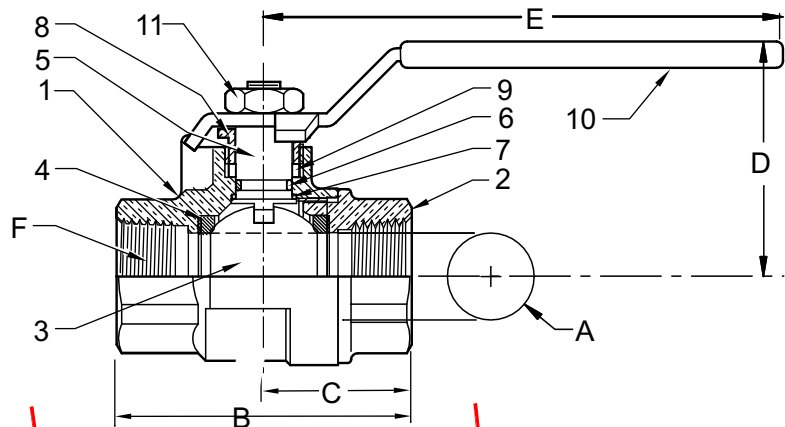
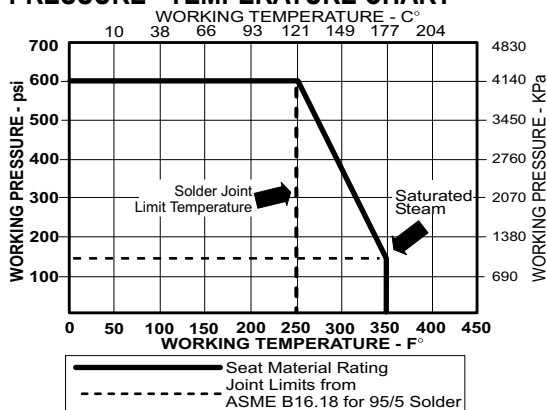
1/4" through 2" Only

MATERIALS LIST

ITEM	PART	MATERIALS	ASTM SPEC.
1	Body	Brass, Forged	B283
2	Tailpiece	Brass, Forged	B283
3	Ball	Brass w/ Chrome Plating	B283
4	Ball Seal	PTFE	Commercial
5	Stem	Brass	B124
6	O-Ring	Buna-N	D2006
7	Thrust Washer	PTFE	Commercial
8	Gland Nut	Brass	B124
9	Packing	PTFE	Commercial
10	Handle	Zinc Plated Steel	Commercial
11	Handle Nut	Zinc Plated Steel	Commercial

CLASSIFIED
UL
 ANSI / NSF 61
 BALL VALVE
 9EA0
WATER QUALITY


*Also Available 8901-07
 (Locks only in closed position)

PRESSURE - TEMPERATURE CHART**DIMENSIONS**

Valve Size	UNITS	1/4"	3/8"	1/2"	3/4"	1"	1-1/4"	1-1/2"	2"	2-1/2"	3"
A	INCHES	.39	.39	.51	.76	1.00	1.26	1.50	2.00	2.48	2.95
	mm	9.9	9.9	12.7	19.3	25.0	32.0	38.1	51.0	63	74.9
B	INCHES	1.87	1.87	2.25	2.62	3.06	3.5	3.75	4.38	5.16	6
	mm	47	47	57	67	78	89	95	111	131.1	152.4
C	INCHES	0.95	0.95	1.12	1.31	1.91	2.21	1.87	2.19	2.58	3
	mm	24	24	61	33	49	56	47	56	65.5	76.2
D	INCHES	1.42	1.42	1.46	1.93	2.10	2.33	2.52	2.96	3.94	4.37
	mm	36	36	37	49	53	59	64	75	100.1	111
E	INCHES	3.14	3.14	3.14	4.35	4.35	5.00	5.00	6.90	7.87	7.87
	mm	80	80	80	110	110	127	127	175	199.9	199.9
F	THREAD SIZE	1/4" NPT	3/8" NPT	1/2" NPT	3/4" NPT	1" NPT	1-1/4" NPT	1-1/2" NPT	2" NPT	2-1/2" NPT	3" NPT
Cv		12	12	18	40	72	112	161	287	448	645
TORQUE	in-lb	16	16	19	58	69	89	124	210	445	563
	N.m	1.8	1.8	2.1	6.5	7.8	10	14	24		
WEIGHT	lbs	0.33	0.34	0.47	0.89	1.24	1.66	2.34	4.94	7.4	10.47
	Kg	.149	.155	.213	.403	.565	.755	1.064	2.245	3.35	4.75

Rev. 6

The information presented on this sheet is correct at the time of publication. Hammond Valve reserves the right to change design, and/or material specifications without notice. For the Installation, Operation and Maintenance Manual (IOM) see the engineering section on our website. For the most current information access www.hammondvalve.com

	BALL VALVES MATERIAL SPECIFICATION	SPEC NO:
	STAINLESS STEEL AND ENTRY FULL BORE BALL VALVE	4.08

SAP PART NUMBER:

CCC DRAWING NUMBER:

MATERIAL: Stainless steel and entry full bore ball valve 1/2" thru 4" size (Reduced Port for 6" & 8" Acceptable) with blow-out proof stem and seat retainer design to permit valve to be dead ended in either flow direction. Valve has lockable feature to lock the valve in either the open or shut position. Type 316 stainless steel body, ball and stem, TFE seats and seals, wrench operated, 150 lb. ANSI B16.5 flanged ends, raised face, 1/2" thru 4" size Face-to-face dimensions to conform to ANSI B16.10 for steel gate valves. Screwed body inserts not acceptable. Gear Operator for 6" and 8" size valves. No asbestos allowed.

RATING: 275 PSIG @ 100 DEG. F. or 110 PSIG @ 353 DEG. F.

MANUFACTURER: Modentic VL-11, Sharpe Valve #50116-R, or equal

SIZES: 1/2" thru 8"

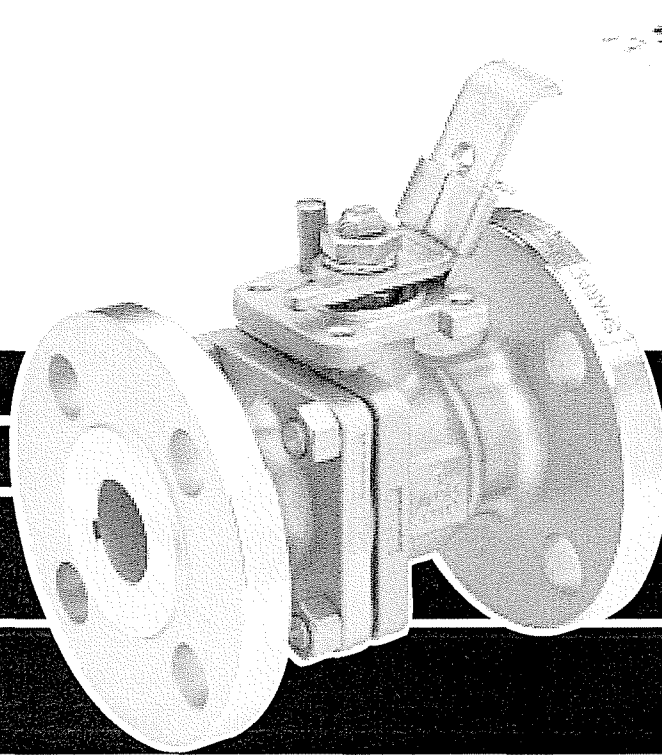
MODELS: Modentic Figure No. VL-11-150 , Figure No. BV-150, or equal.

Issue Date: 01/01/89 Revision Date: 09/15/99

Approved by Joseph P. McMahon on 07/17/2001

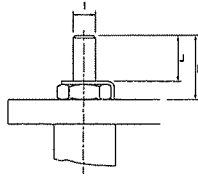
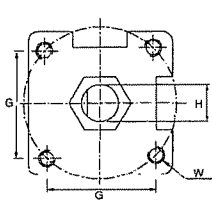
Spec. 4.08

SHARPE[®] VALVES

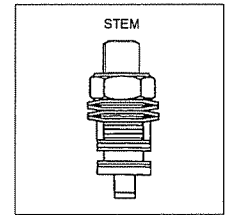
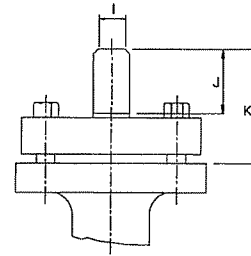
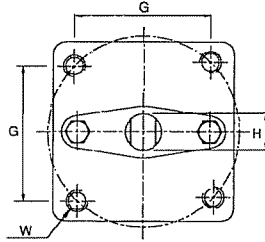


**FLANGED FULL PORT
BALL VALVE
SERIES 50 / CLASS 150**

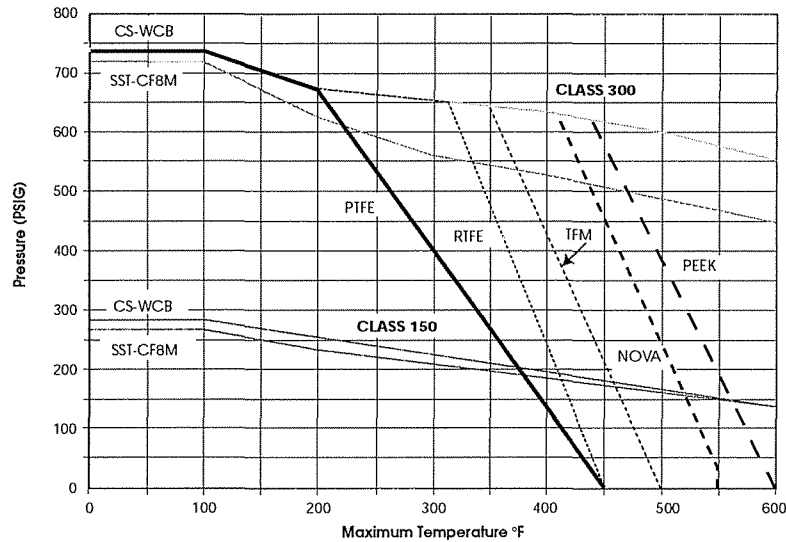
1/2" - 4"



6" - 8"

1/2" - 4"
STEM ARRANGEMENT
FOR ACTUATORS

SEAT PRESSURE/TEMPERATURE RATING SERIES 50



HOW TO ORDER

VALVE SIZE	VALVE SERIES	CLASS	ALLOY	SEATS	OPTIONS
1/2" 3/4" 1" 1-1/2" 2" 2-1/2" 3" 4" 6" 8"	50	150# = 11	2 = Alloy 20 4 = Carbon Steel 6 = Stainless Steel 5 = Hastelloy C 3 = Monel	T = TFE R = RTFE N = NOVA P = Peek M = TFM™	X = Oxygen Service OH = Oval Handle F = Fugitive Emissions Certified ANSI 593.00.01 E = Extended Stem L = Lockable Extended Stem D = Leak detection Stem GO = Gear Operator 7 = 17-4PH Stem A = Nace



3/4"

50

11

6

T

X

SHARPE VALVES

A DIVISION OF **Sluon**

Toll-Free 1-877-7SHARPE
E-Mail: sharpediv@aol.com
www.sharpevalves.com

504 West Wrightwood Ave.
Elmhurst, IL 60126

SERIES 50

VALVE PARTS AND IDENTIFICATION

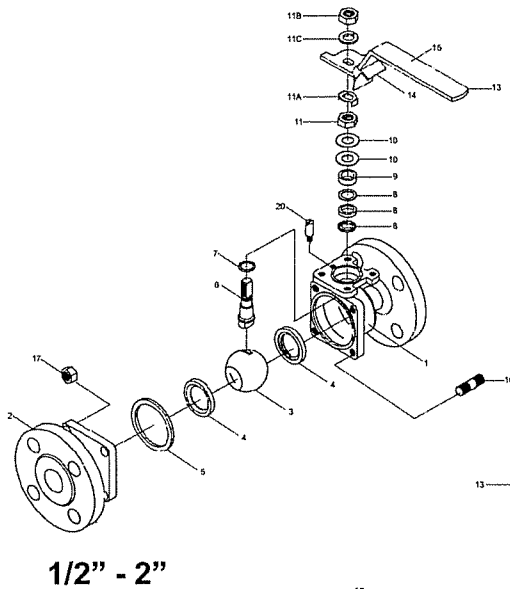
Spec. 4.08

CLASS 150

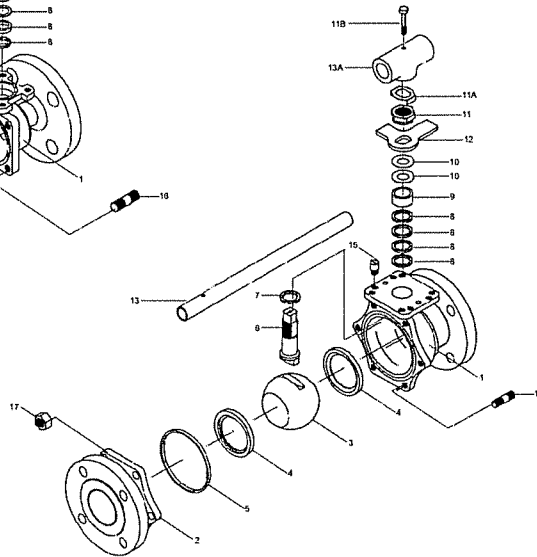
BLOW OUT PROOF STEM

LOCKING DEVICE

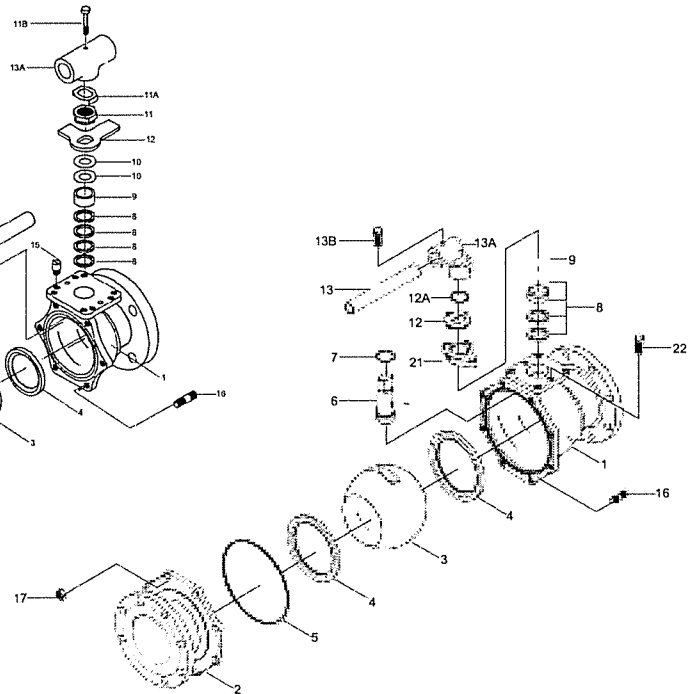
APPLICABLE STANDARDS	
Wall Thickness	ASME B 16.34
Face to Face Dimensions	ASME B 16.10
Flange Dimensions	ASME B 16.5
Pressure Tests	ASME B 16.34 API 598 (Optional)
Basic Design	ASME B16.34



1/2" - 2"



2-1/2" - 4"



6" - 8"

PART NO.	PART	QTY.	MATERIAL
1	Body	1	316 Stainless Steel ASTM A351 CF8M Alloy 20 ASTM A351 CN7M Carbon Steel ASTM A216 WCB Hastelloy C ASTM A494 GR CW-12MW Monel ASTM A494 GR M35-1
2	End Connector	1	316 Stainless Steel ASTM A351 CF8M Alloy 20 ASTM A351 CN7M Carbon Steel ASTM A216 WCB Hastelloy C ASTM A494 GR CW-12MW Monel ASTM A494 GR M35-1
3	Ball	1	316 Stainless Steel Alloy 20 Hastelloy C
4	Seat	2	TFM(Super TFE) TFE Reinforced TFE NOVA PEEK
5	Body Seal	1	TFE
6	Stem	1	316 Stainless Steel Alloy 20 Hastelloy C 17-4PH (Option)
7	Thrust Bearing	2	Reinforced TFE
8	Stem Packing	3/4	Reinforced TFE
9	Gland Packing	1	304 Stainless Steel
10	Belleville Washer (1/2"-4")	2/4	304 Stainless Steel
11	Packing Nut (1/2"-4")	1	304 Stainless Steel
11A	Lock Tab	1	Stainless Steel
11B	Handle Nut	1	304 Stainless Steel
11C	Lock Washer	1	304 Stainless Steel (1/2"-2")

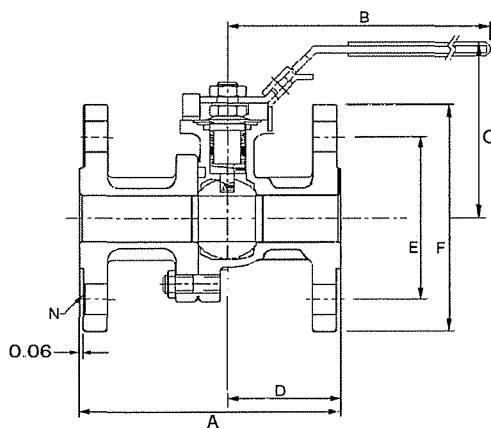
PART NO.	PART	QTY.	MATERIAL
12	Stopper	1	304 Stainless Steel
12A	Snap Ring	1	Stainless Steel (6"-8")
13	Handle	1	304 Stainless Steel (1/2"-2") Galvanized Steel (2-1/2"-4") Ductile Iron (6"-8")
13A	Wrench Block	1	Stainless Steel
13B	Hex Head Bolt	1	304 Stainless Steel
14	Locking Device (1/2"-2")	1	304 Stainless Steel
15	Sleeve	1	Vinyl
16	Body Stud	SEE* N	A193 B8 (SST) A193 B7 (CS)
17	Nut	SEE* N	A194 8 (SST) A194 2H (CS)
20	Stop Pin (1/2"-2") (2-1/2"-4")	1 2	304 Stainless Steel 304 Stainless Steel
21	Gland Flange (6"-8")	1	304 Stainless Steel
22	Gland Bolts (6"-8")	2	304 Stainless Steel

*See Dimensions

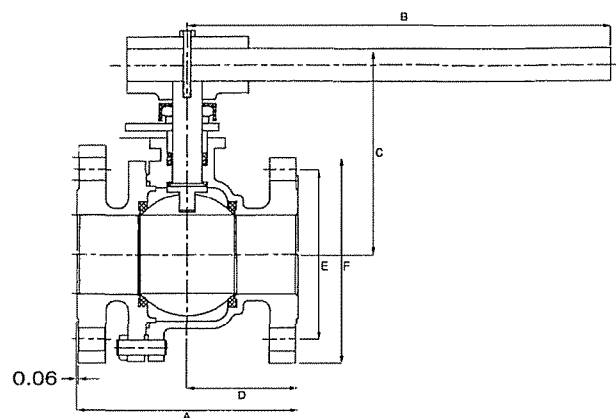
SERIES 50 DIMENSIONS

Spec. 4.08

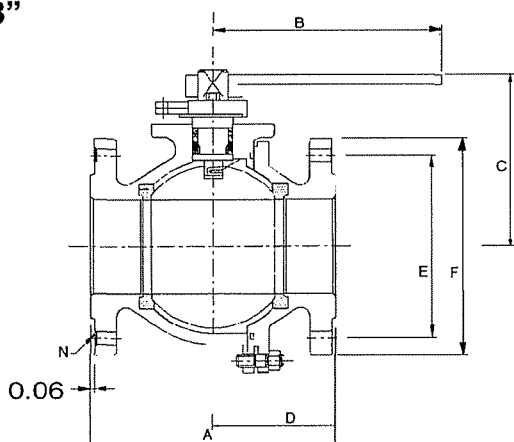
1/2" - 2"



2-1/2" - 4"



6" - 8"



CV DATA

1/2"	26
3/4"	50
1"	94
1-1/2"	260
2"	480
2-1/2"	750
3"	1300
4"	2300
6"	5400
8"	10000


PORT

1/2"	0.59
3/4"	0.78
1"	1.00
1-1/2"	1.50
2"	2.00
2-1/2"	2.55
3"	3.00
4"	4.00
6"	6.00
8"	7.88

WEIGHT (lbs.)

1/2"	4
3/4"	6
1"	8
1-1/2"	15
2"	20
2-1/2"	36
3"	45
4"	75
6"	135
8"	290

SIZE	A	B	C	D	E	F	N	G	H	I	J	K	W
1/2"	4.25	4.75	3.60	1.80	2.38	3.50	4	1.39	3/8-24 UNF	.22	.28	.63	M5
3/4"	4.62	4.75	3.75	2.00	2.75	3.85	4	1.39	3/8-24 UNF	.22	.28	.63	M5
1"	5.00	6.22	3.75	2.12	3.13	4.25	4	1.39	7/16-20 UNF	.30	.30	.90	M6
1-1/2"	6.50	9.00	4.50	2.76	3.56	5.00	4	1.94	9/16-18 UNF	.35	.42	1.18	M8
2"	7.00	9.00	4.80	3.08	4.75	6.00	4	1.94	9/16-18 UNF	.35	.42	1.18	M8
2-1/2"	7.50	13.75	6.70	3.09	5.50	7.00	4	2.84	M20	.55	.55	1.83	M10
3"	8.00	13.75	7.00	3.74	6.00	7.48	4	2.84	1-14 UNS	.745	.66	1.83	M10
4"	9.00	13.75	7.70	4.46	7.50	9.01	8	2.84	1-14 UNS	.745	.66	1.83	M10
6"	15.50	38.97	11.22	7.61	9.50	10.98	8	3.89	1.02	1.64	1.46	3.00	M12
8"	18.00	38.97	11.57	8.34	11.75	13.50	8	4.59	1.02	1.64	1.46	3.00	M12

	BALL VALVES MATERIAL SPECIFICATION	SPEC NO:
	STAINLESS STEEL END ENTRY REGULAR PORT BALL VALVE	4.57

SAP PART NUMBER:

CCC DRAWING NUMBER:

MATERIAL: Stainless steel end entry regular port ball valve with blowout proof stem and seat retainer design to permit valve to be dead ended in either flow direction. ASTM A-296, Grade CF8M Type 316 stainless steel body, ball and stem, TFE seats and seals, wrench operated, threaded ends. Screwed body inserts or tail pieces not acceptable.

RATING: 80 PSIG @ 400 DEG. F. or 1500 PSIG @ 150 DEG. F.

MANUFACTURER: Modentic, Sharpe Valve #54576, Jamesbury, or equal.

SIZES: 1/4" thru 2"

MODELS: Modentic Figure No. V-008, Jamesbury Bulletin 210, Trueline - N600LL, or equal

Issue Date: 01/01/89 Revision Date: 09/15/99

Approved by Joseph P. McMahon on 07/17/2001

Spec. 4.57

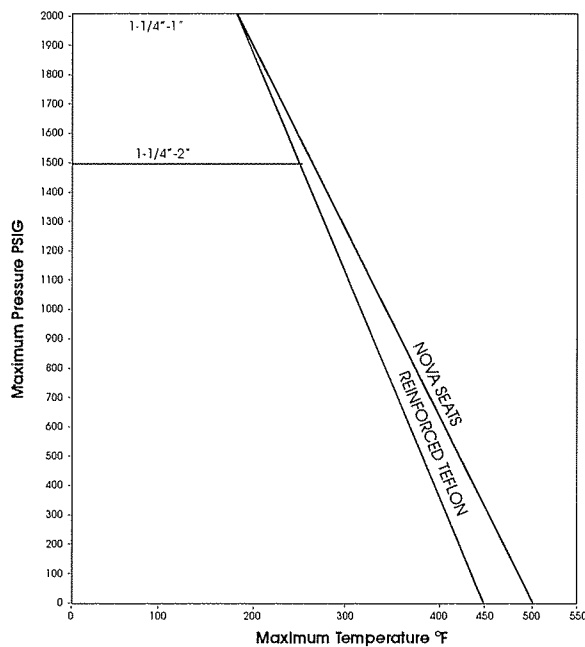
SHARPE[®] VALVES

**SERIES 5457
THREADED STANDARD
PORT BALL VALVE**

SHARPE® VALVES

Spec. 4.57

PRESSURE TEMPERATURE RATINGS



HOW TO ORDER

VALVE SIZE	VALVE SERIES	BODY & ENDS	SEAT & SEAL
1/4" 3/8" 1/2" 3/4" 1" 1-1/4" 1-1/2" 2"	5457	4 = Carbon Steel 6 = Stainless Steel	RT Seats PTFE Seats as Standard N = Nova Seats/ Graphoil Seal

3/4"

5457

4

N



Toll-Free 1-877-7SHARPE
Web Site: www.sharpevalves.com

1260 Garnet Drive
Northlake, Illinois 60164 U.S.A

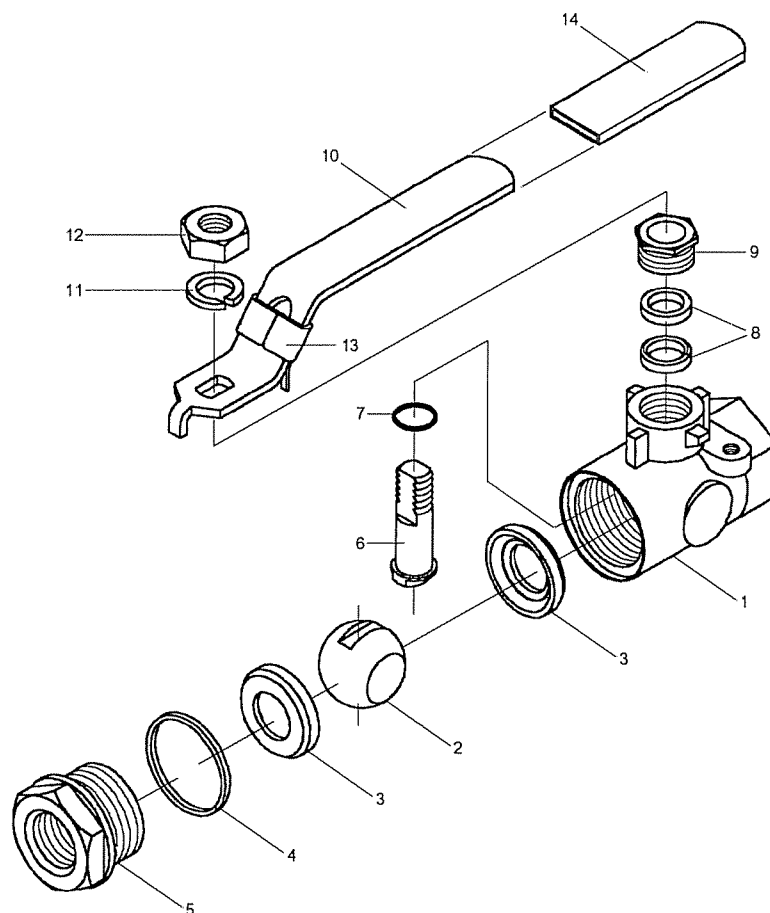
Due to continuous development of our product range we reserve the right to change the dimensions and information contained in the leaflet as required.

SERIES 5457

VALVE PARTS AND IDENTIFICATION

Spec. 4.57

ASTM-A216
 ASTM-A351
 1/4" - 1" 2000 lb. WOG
 1-1/4" - 2" 1500 lb. WOG
 LOCKING DEVICE
 ACTUATOR MOUNTING PAD
 STANDARD PORT
 BLOWOUT PROOF STEM
 STEAM RATINGS: (SATURATED)
 WITH REINFORCED TEFLON
 SEATS 150 WSP
 WITH NOVA SEATS 250 WSP



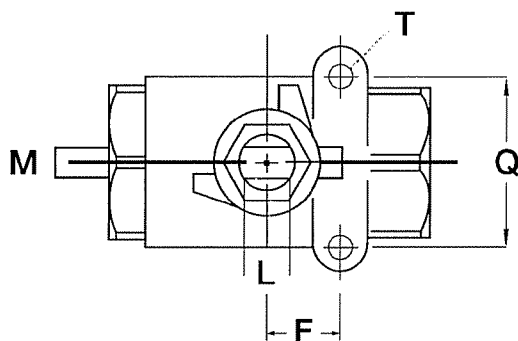
PART NO.	PART	QTY.	MATERIAL
1	Body	1	ASTM-A216 WCB ASTM-A351 CF8M
2	Ball	1	316 Stainless Steel
3	Seat	2	RPTFE / NOVA
4	Body Seal	1	PTFE / Graphite
5	End Plug	1	ASTM-A216 WCB ASTM-A351 CF8M
6	Stem	1	316 Stainless Steel
7	Thrust Washer	1	PTFE
8	Stem Packing	2	PTFE / Graphoil
9	Packing Nut	1	Stainless Steel - 316
10	Handle	1	Stainless Steel - 304
11	Lock Washer	1	Stainless Steel - 304
12	Handle Nut	1	Stainless Steel - 304
13	Locking Device	1	Stainless Steel - 304
14	Handle Sleeve	1	Plastic

SERIES 5457

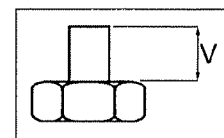
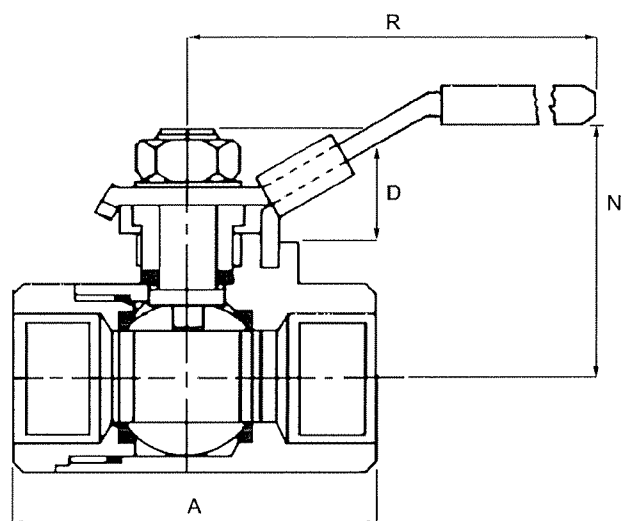
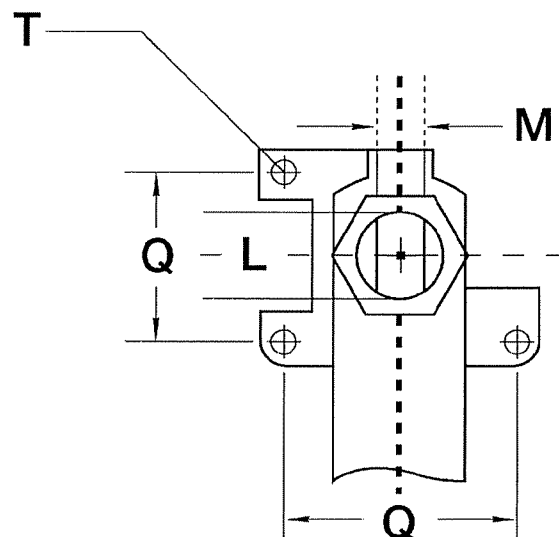
VALVE DIMENSIONS

Spec. 4.57

1/4" - 1"



1-1/4" - 2"




1/4" - 2"
STEM ARRANGEMENT
FOR SERIES 5457

SIZE	A	D	N	R	Q	F	M	L	T	V	PORT SIZE	APPROX. WEIGHT
1/4"	2.25	0.95	1.75	4.00	1.10	0.45	0.22	0.30	10 - 24	0.30	0.50	0.60
3/8"	2.25	0.95	1.75	4.00	1.10	0.45	0.22	0.30	10 - 24	0.30	0.50	0.60
1/2"	2.32	1.12	2.00	4.00	1.10	0.45	0.22	0.30	10 - 24	0.32	0.50	0.55
3/4"	3.12	1.20	2.20	5.00	1.35	0.85	0.25	0.42	10 - 24	0.35	0.70	1.10
1"	3.37	1.20	2.45	5.00	1.35	0.85	0.25	0.42	10 - 24	0.35	0.88	1.50
1-1/4"	4.10	1.06	3.40	5.75	1.40*	---	0.37	0.61	1/4 - 20	0.50	1.00	2.75
1-1/2"	4.35	1.10	3.40	5.75	1.40*	---	0.37	0.61	1/4 - 20	0.50	1.25	3.50
2"	5.40	1.10	3.75	5.75	1.40*	---	0.37	0.61	1/4 - 20	0.50	1.50	5.25

CV* DATA

1/4"	6
3/8"	6
1/2"	9
3/4"	24
1"	35
1-1/4"	47
1-1/2"	81
2"	105

*CV: The volume of water in gal./min. that will pass through a given valve with a pressure drop of 1 PSI.

	STRAINERS MATERIAL SPECIFICATION	SPEC NO:
	SAMPLE PORT SEPTUM, TYPE 316 STAINLESS STEEL	22.27

SAP PART NUMBER: 1001381

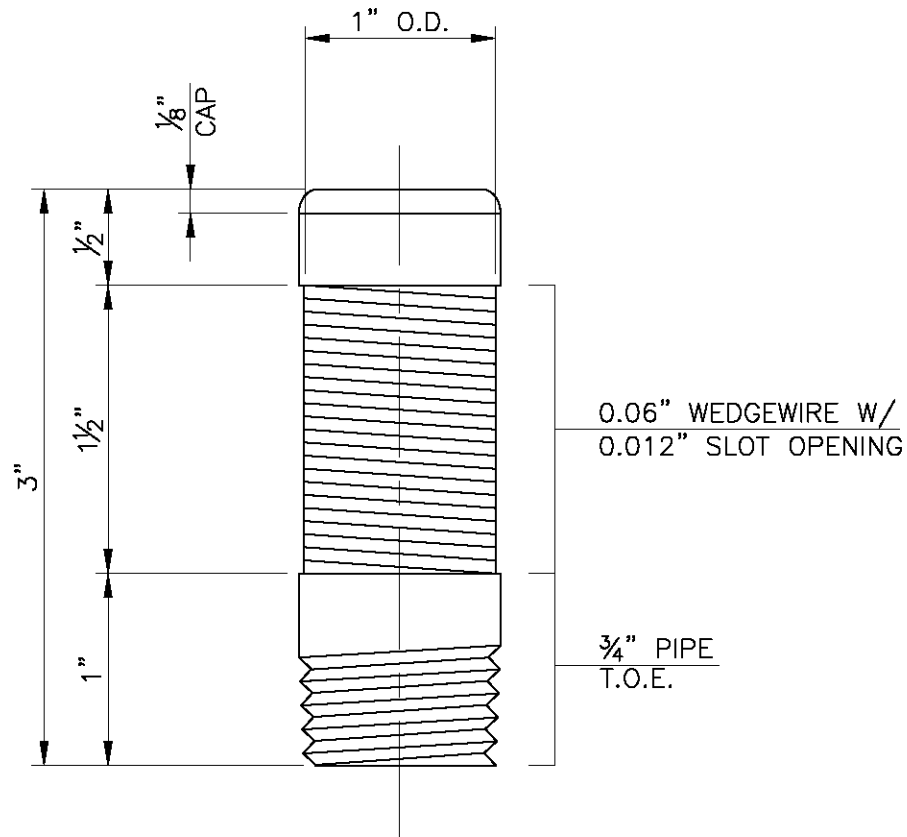
CCC DRAWING NUMBER: 90070014

MATERIAL: Sample port septum, Type 316 stainless steel, 0.060" wedge wire with 0.008" slot opening, Septum to be 1" O.D. x 1 1/2" long with 3/4" MNPT end fitting 1" long, Overall Length= 3"

MANUFACTURER: Orthos or approved equal

Issue Date: Revision Date: 10/21/2010

Approved by Joseph P. McMahon on 10/21/2010



MATERIAL: 316 STAINLESS STEEL

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	NAME	DATE
DRAFTER	JFS	5-12-05
DESIGNER		
CHECKER		
APPROVAL		
PROJECT No.	STANDARD	



CALGON CARBON CORPORATION


CLIENT

TITLE

SAMPLE PORT
SEPTA DETAIL
CCC SPEC.: 22.27

DWG. Size	A	SHEET No.	1 OF 1	SCALE	NONE
DWG. No.	90-07-0014			REV.	0

REV	DESCRIPTION	APP	DATE
0			10-3-07
REVISIONS			

	STRAINERS MATERIAL SPECIFICATION	SPEC NO:
	BASKET STRAINER, TYPE 316 STAINLESS STEEL	22.53

SAP PART NUMBER:

CCC DRAWING NUMBER:

MATERIAL: Perforated basket strainer (Carbon Retainer) for 150 lb. Raised Face Flanges, type 316 stainless steel construction. Basket is to be Fabricated from 14 Gage 316 stainless steel with 1/8" holes drilled on 3/16" centers and covered with 40 mesh 316 stainless steel screen, this will then be covered by a 4 mesh 316 stainless steel support screen (0.063" wire diameter).

RATING: Support Screen is to be designed for 125 PSIG if plugged in forward or reverse flow.

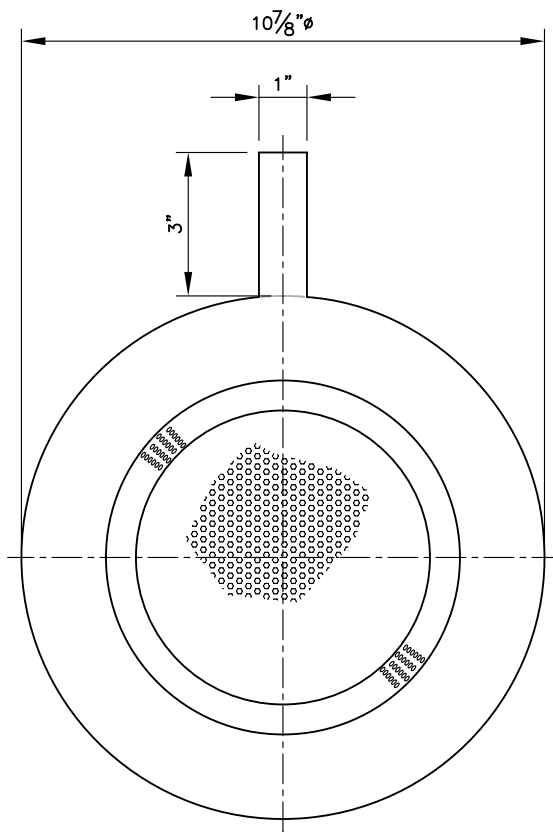
MANUFACTURER: Mack Iron Works Company, or equal.

SIZES: 2" thru 12"

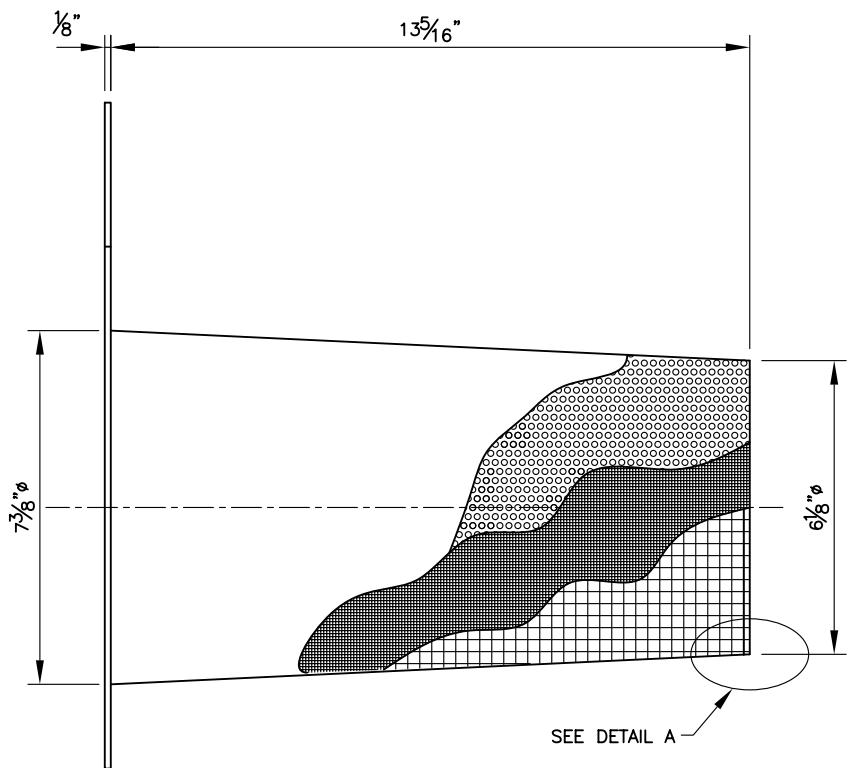
MODELS: Mack Iron Works Company Series PB-R/FF, Style PBL or equal.

Issue Date: 01/01/90 Revision Date: 08/23/90

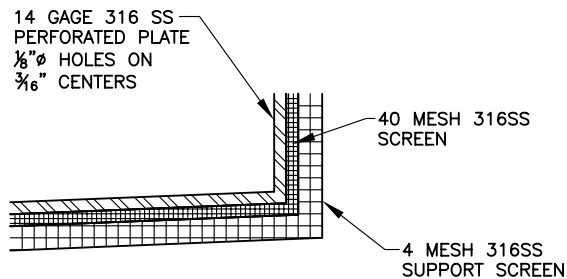
Approved by Matthew R. McGowan on 06/16/99



FRONT



SIDE



DETAIL A

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NAME	DATE
DRAFTER BKM	8/29/06
DESIGNER	
CHECKER RES	4/3/07
APPROVAL	
PROJECT No.	STANDARD

2			
1			
0	ISSUED FOR FABRICATION	RES	4/3/07
REV	DESCRIPTION	APP	DATE
REVISIONS			



CALGON CARBON CORPORATION

CLIENT	STANDARD		
TITLE	8" STRAINER, 316L SS CCC SPEC 22.53 DETAILS		
DWG. Size A	SHEET No. 1 OF 1	SCALE	NONE
DWG. No.	90060220	REV.	0

	STRAINERS MATERIAL SPECIFICATION	SPEC NO:
	FILTER NOZZLE, POLYPROPYLENE	22.96

SAP PART NUMBER:

CCC DRAWING NUMBER:

MATERIAL: Filter nozzle, 0.012" (0.3mm) slot size, M24 thread x 45mm long stem complete with MUZ slots. Base shoulder is 10 mm in length. Furnish MUZ type nut and washer, and a 2.5"O.D. x 1-1/8" I.D. x 1/8" thick white Buna N (FDA approved) gasket. All plastic parts shall be manufactured from virgin polypropylene. All polypropylene parts to be colored green. Calgon Carbon Logo and Spec. Number to be molded on the top.

MANUFACTURER: Orthos, or equal.

MODELS: Type C2, or equal.
Kit Number: N11031
Nozzle Part Number: C2.0.3.M24.45.MUZ.PP

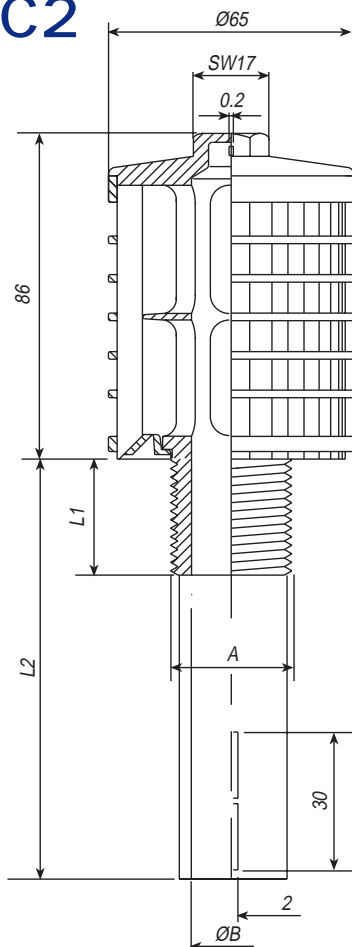
Issue Date: 12/01/89 Revision Date: 07/31/2003

Approved by Joseph P. McMahon on 08/21/2003

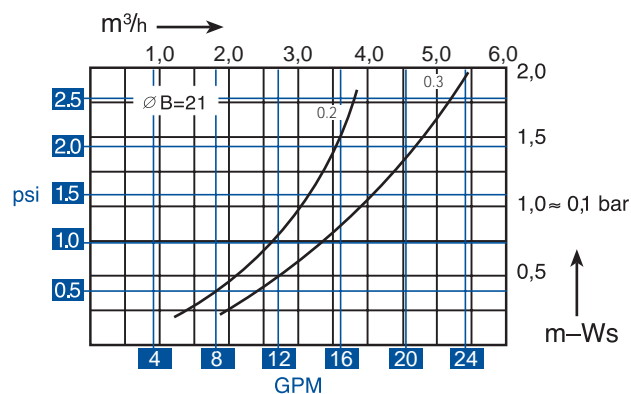
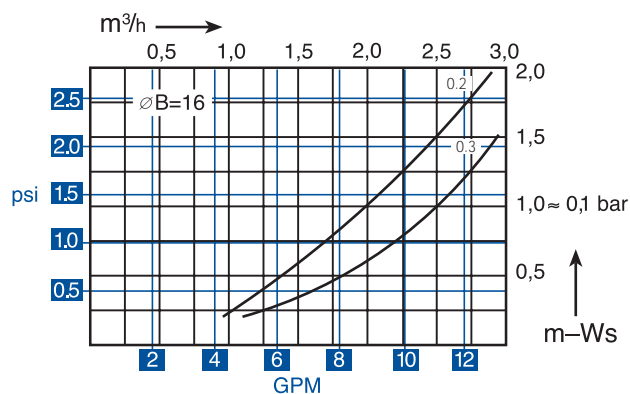
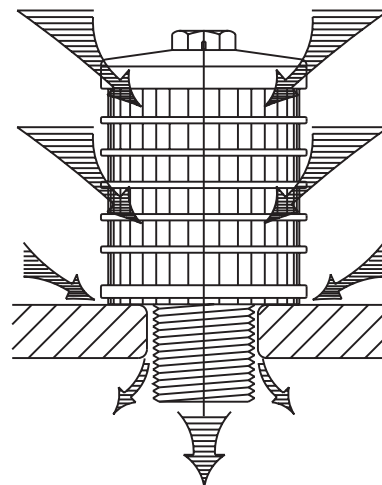
Filter Nozzles

Spec. 22.96

Model C2



All dimensions in mm unless otherwise noted.



Model C2 Ordering Information

Slots	Thread	ØA	Thread Length — L1	Shaft — L2	ØB
36 x 0.2 = 3.70 cm²	3/4" NPT				16 = 2.00 cm²
36 x 0.3 = 5.50 cm²	1" NPT				21 = 3.40 cm²
	M24	24	20, 45, +5 + 5...	L1, 80, 110, 140, 200, up to 400	16 = 2.00 cm²
	1" WW	25.4	45	L1, 80, 110, 140, 200, up to 400	16 = 2.00 cm²
	1-1/4" WW	32	20, 30, 45,	L1, 80, 110, 140, 200, up to 400	21 = 3.40 cm²
	G3/4"	26.5	20, 45, + 5 + 5...	L1, 80, 110, 140, 200, up to 400	16 = 2.00 cm²

Design

For general purposes the filter nozzles should be placed on 6" centers, with 8" centers being the maximum recommended (subject to the filter media, single or multi-layer, depth of bed, etc.). The filter nozzles are available in a wide variety of slot sizes to suit the media; and airtubes and tailpipes for air or water backwash can be provided as required.

Consistency of the Material

Filter nozzles made of polypropylene are resistant to many chemicals including the following examples:

@ 140°F / 60°C

- ammonia 10%
- formaldehyde 10%
- isopropanol all concentrations
- methanol 50%
- caustic soda solution 50%
- hydrochloric acid 10%
- sulfuric acid 10%
- soda water
- ozone (68°F/20°C, 50 ppm)

In addition to virgin polypropylene (max. temperature 140°F), all filter nozzles are also available in glass fiber reinforced polypropylene (max. temperature 230°F) and Kynar (max. temperature 275°F). Other available materials include stainless steel, alloy 20 and hastelloy.

Installation Specifications

Recommended Torque 4.0 ft. lbs.

Max RPM 430

In lower temperatures polypropylene becomes more brittle. If nozzles are to be installed in cold weather, we recommend that all polypropylene materials are first warmed before installation.

When using with hot water (max. continuous temperature up to 230°F / 110°C, polypropylene with chemically combined 30% glass fiber is recommended.

PVDF is recommended for hot water with a continuous temperature of up to 275°F / 135°C. (Conditionally resistant to concentrated caustic solutions.)

Color Coded Polypropylene Nozzles


Slot Size	Color
0.2	ivory
0.3	green
0.35	white
0.5	grey
0.7	yellow
0.8	blue
1.0	black
1.5	orange
2.0	green

All specifications are subject to change without notice.

Conversion Chart

Multiply units in left column by proper factor below

LENGTH	in.	ft.	mm	cm	m
1 inch	1	0.0833	25.4	2.540	0.0254
1 foot	12	1	304.8	30.48	0.3048
1 millimeter	0.0394	0.0033	1	0.100	0.001
1 centimeter	0.3937	0.0328	10	1	0.01
1 meter	39.37	3.281	1000	100	1
AREA	in. ²	cm ²			
1 inch ²	1	6.452			
1 centimeter ²	0.1550	1			
VOLUME	liter	U.S. gal.			
1 liter	1	0.2642			
1 U.S. gallon	3.785	1			
VOLUME RATE	gallon/min.	m ³ /hr.	liter/hr.		
1 gallon/minute	1	0.227	227		
1 m ³ /hour	4.403	1	1000		
1 liter/hour	0.063	0.001	1		
PRESSURE	lbs./in. ²	ft. water at 39.2°F	bar		
1 pound/in. ²	1	2.307	0.069		
1 foot water	0.4335	1	0.0299		
1 Bar	14.50	33.45	1		

	EXPANSION JOINTS MATERIAL SPECIFICATION	SPEC NO:
	RUBBER EXPANSION JOINT, DOUBLE ARCH TYPE	24.06

SAP PART NUMBER:

CCC DRAWING NUMBER:

MATERIAL: Rubber expansion joint, double arch type, molded neoprene reinforced with multiple plies of nylon. Joint allows 4 way movement and 30 DEG. angular misalignment. Has loose steel backing flanges to be galvanized or zinc plated, 150 # drilling. No gaskets required. Control unit assemblies for pressures specified as 135 psi or greater.

RATING: 225 psi @ 170 DEG. F.

MANUFACTURER: Dynex, Inc., Proco Products, Inc., or Approved Equal.

SIZES: 1" thru 12"

MODELS: Dynex Series 702, Proco Products, Inc., Model 242-A-NN-4, with "blue" I.D. label or Approved Equal.

Issue Date: 01/01/89 Revision Date: 08/30/99

Approved by Matthew R. McGowan on 08/30/99

PROCOTM

SERIES

240/242

molded expansion joints

Spec. 24.06



PROCO Series 240 and Series 242 Non-Metallic Expansion Joints are designed for tough demanding industrial applications as found in: Air Conditioning-Heating and Ventilating Systems, Chemical-Petrochemical and Industrial Process Piping Systems, Power Generating Systems, Marine Services, Pulp & Paper Systems, Water-Waste-water-Sewage and Pollution Control Systems. Installed next to mechanical equipment or between the anchor points of a piping system, specify the PROCO Series 240 or 242 to: (1) Absorb Pipe/Movement/Stress, (2) Reduce System Noise, (3) Isolate Vibration, (4) Compensate Alignment/Offset, (5) Eliminate Electrolysis, (6) Protect Against Start-Up/Shutdown Forces. Our history in the manufacturing of expansion joint products dates back to 1930. When you need an engineered rubber solution to a piping system problem, call PROCO.

Spherical Shapes-Stronger-More Efficient. Featuring an engineered molded style single or twin sphere designed bellows, the PROCO Series 240 and Series 242 are inherently stronger than the conventional hand-built Spool Type arch. Internal pressure within a sphere is exerted in all directions, distributing forces evenly over a larger area. The spherical design "flowing-arch" reduces turbulence, sediment buildup, thrust area and the effects of thrust on the piping system equipment when compared to the "high-arch" design of hand-built standard products.

Greater Movements Are Available with the PROCO Series 240 and Series 242 when compared to the movements of conventional hand-built products. Axial compression, elongation, deflection and angular movements in the system are more readily absorbed by spherical types. These products are more forgiving and can be compressed or extended to install in non-standard openings, caused by equipment shifting or settling (Pre-compressing/extending the expansion joints for installation, may result in reduced pressure, vacuum and movement capabilities of the expansion joints. See Tables 2 and 3.)

Easy Installation With Alignable Metallic Flanges. The floating metallic flanges freely rotate on the bellows, compensating for mating flange misalignment, thus speeding up installation time (see Figures 1, 2, 3 & 4). Gaskets are also not required with the Series 240 or Series 242, provided the expansion joints are mated against a flat face flange as required in the installation instructions.

Less System Strain With Thin Wall Design. Manufactured by high pressure molding of elastomer and high-tensile fabric reinforcement, the Series 240 and Series 242 have a thinner wall section and lighter weight when compared to conventional hand-built products. Lower spring forces are therefore required, reducing piping/flange/equipment stress-strain-damage. PROCO Styles 240-C and 240-A are acceptable for use with plastic piping systems where even lower deflection forces are required.

Specifications Met. The PROCO Series 240 and Series 242 are designed to meet or exceed the pressure, movement and dimensional rating of the Spool Type arch as shown in the Rubber Expansion Joint Division, Fluid Sealing Association "Technical Handbook - Sixth Edition" Tables IV & V.

Absorbs Vibration-Noise-Shock. The PROCO quiet operating Series 240 and Series 242 are a replacement for "sound transmitting" metallic expansion joints. Sound loses energy traveling axially through the elastomer bellows. Water hammer pumping impulses and water-borne noises are cushioned and absorbed by the molded lightweight thin-wall structure. Install the Series 240 or Series 242 in a system to enable isolated equipment to move freely on its vibration mountings; or to reduce vibration transmission when the piping section beyond the expansion joint is anchored or sufficiently rigid.

Flange Materials/Drilling. All PROCO Spherical 240 and 242 connectors are furnished complete with plated carbon steel flanges for corrosion protection. Series 240 and 242 Neoprene connectors — 12" and below — are tapped to ANSI 125/150# drilling. All other connectors come with standard drilled holes to the ANSI 125/150# standards (see Table 7 and Figures 3 & 4). Stainless steel flanges and other drilling standards such as: ANSI 250/300#, BS-10, DIN NP-10 and DIN NP-16 are also available from stock and are listed on Table 7. JIS-5K and JIS-10K are also available upon request.

Chemical Service Capability At Minimal Cost. Expensive, exotic metal expansion joints for chemical service can be replaced with the PROCO Series 240 or Series 242. Molded with low cost chemical resistant elastomers such as Neoprene, Nitrile, Hypalon®, EPDM and Chlorobutyl insures an expansion joint is compatible with the fluid being pumped or piped. (See Table 1 below). Use the PROCO "Chemical/Rubber Guide" to specify an elastomer recommendation compatible for your requirement.

Wide Service Range With Low Cost. Engineered to operate up to 300 PSIG and 265°F, the PROCO Series 240 and Series 242 can be specified for a wide range of piping requirements. Compared to conventional hand-built Spool Type arch, you will invest less money when specifying the mass-produced, consistent high quality, molded single or twin sphere expansion joints.

Large Inventories Mean Same-Day Shipment. PROCO maintains the largest inventory of spherical expansion joints in the Americas. Every size listed is in stock in several elastomers and comes with a choice of drilling patterns. Shipment is based on customer need. PROCO can ship same day as order placement. In fact, when it comes to rubber expansion joints, **if PROCO doesn't have your requirement...nobody does!**

Information • Ordering • Pricing • Delivery. Day or night, weekends and holidays ... the PROCO phones are monitored 24 hours around the clock. When you have a question, you can call us.

Toll-Free Phone 800 / 344-3246 USA/CANADA
International Calls 209 / 943-6088
Fax 209 / 943-0242
E-mail sales@procoproducts.com
Website www.procoproducts.com

Weekday office hours are 5:30 a.m. to 5:15 p.m. (Pacific Time)

Table 1: Available Styles • Materials

For Specific Elastomer Recommendations, See: PROCO TM "Chemical To Elastomer Guide"								
240-A	240-C	240-AV, D, E, M	242-A, B, C	PROCO TM Material Code ¹	Cover Elastomer ²	Tube Elastomer	Maximum Operating Temp. °F	Identifying Color Band/Label
	X	X	X	/BB	Chlorobutyl	Chlorobutyl	250°	Black
	X	X	X	/EE	EPDM	EPDM	250°	Red
	X			/EE-9	EPDM	EPDM	265°	Red
	X			/ET-9 ³	EPDM	Teflon®	265°	Red
	X			/HH	Hypalon®	Hypalon®	230°	Green
		X	X	/NH	Neoprene	Hypalon®	230°	Green
	X			/NJ	Neoprene	FDA-Nitrile	230°	White
		X	X	/NN	Neoprene	Neoprene	230°	Blue
	X	X	X	/NP	Neoprene	Nitrile	230°	Yellow
X	X			/NT ³	Neoprene	Teflon®	230°	

NOTES: Hypalon® is a registered trademark of DuPont Dow Elastomers. Teflon® is a registered trademark of the DuPont Company.

- All elastomers include nylon reinforcing, except EE-9 which is steel cord.
All materials meet or exceed the Rubber Expansion Joint Division, Fluid Sealing Association-REJ Division requirements for Standard Class I and II. EE-9 also meets Special Class II. For more information see The FSA Technical Handbook, Table 1.
Materials NN, NP and NH meet all requirements of U.S.C.G.
EPDM Materials good for up to 300°F for pressures 15 PSI or less.
- Expansion joint "cover" (outside) can be Hypalon® painted on special order.
- Products with Teflon® "tube" (inside) are not to be used for vacuum service.

Protecting Piping And Equipment Systems From Stress/Motion

series 242 twin sphere expansion joints

Spec. 24.06

Table 3: Sizes • Movements • Pressures • Flange Standards • Weights

NOMINAL PIPE		PROCO	242 Movement Capability: From Neutral Position ²					Pressure ⁴		Standard Flange Bolting Dimensions					Weight in lbs ⁸	
			Axial Compression Inches	Axial Extension Inches	Lateral Deflection Inches	Angular Deflection Degrees	Thrust ³ Factor	Positive ⁵ PSIG	Vacuum ⁶ Inches of Hg	Flange O.D. Inches	Bolt Circle Inches	Number of Holes	Size of Holes Inches	Bolt Hole ⁷ Thread	Exp. Joint & Flanges	Control Unit Set (2 Rod)
1	10.00	242-C	2.000	1.188	1.750	45	4.43	225	26	4.25	3.13	4	0.500	—	5.2	3.6
1.25	7.0	242-A	2.000	1.188	1.750	45	6.34	225	26	4.63	3.5	4	0.500	1/2-13 UNC	5.3	3.5
	7.0	242-HA						300					0.500		6.5	3.5
	10.00	242-C						225					0.500		6.2	3.6
1.5	6.00	242-B	2.000	1.188	1.750	45	6.49	225	26	5.0	3.88	4	0.500	1/2-11 UNC	6.1	4.6
	6.00	242-HB						300					0.500		7.6	4.6
	7.00	242-A						225					0.500		6.8	4.8
	7.00	242-HA						300					0.500		8.3	4.8
2	10.00	242-C	2.000	1.188	1.750	45	7.07	225	26	6.0	4.75	4	0.500	5/8-11 UNC	7.7	5.1
	6.00	242-B						300					0.625		9.0	6.6
	6.00	242-HB						225					0.625		10.5	6.6
	7.00	242-A						225					0.625		9.0	7.0
2.5	7.00	242-HA	2.000	1.188	1.750	43	11.05	300	26	7.0	5.5	4	0.625	5/8-11 UNC	10.5	7.0
	6.00	242-B						225					0.625		12.9	7.6
	6.00	242-HB						300					0.625		15.3	7.6
	7.00	242-A						225					0.625		13.3	8.0
3	10.00	242-C	2.000	1.188	1.750	38	13.36	300	26	7.5	6.0	4	0.625	5/8-11 UNC	15.8	8.0
	7.00	242-B						225					0.625		15.2	9.0
	9.00	242-HA						300					0.625		15.8	9.1
	10.00	242-C						225					0.625		16.0	9.9
3.5	10.00	242-C	2.000	1.188	1.750	34	18.67	225	26	8.5	7.0	8	0.625	—	20.6	8.1
4	9.00	242-A	2.000	1.375	1.562	34	22.69	225	26	9.0	7.5	8	0.625	5/8-11 UNC	20.3	8.0
	9.00	242-HA						300					0.750		26.4	8.0
	10.00	242-C						225					0.750		21.3	8.2
	12.00	242-C						225					0.750		22.0	8.2
5	9.00	242-A	2.000	1.375	1.562	29	30.02	225	26	10.0	8.5	8	0.750	—	24.5	8.3
	9.00	242-HA						300					0.750		31.4	8.3
	10.00	242-C						225					0.750		25.5	9.1
	12.00	242-C						225					0.750		26.0	9.1
6	9.00	242-A	2.000	1.375	1.562	25	41.28	225	26	11.0	9.5	8	0.750	3/4-10 UNC	29.5	11.7
	9.00	242-HA						300					0.750		38.6	11.7
	10.00	242-C						225					0.750		30.5	11.9
	12.00	242-C						225					0.750		31.0	12.0
8	14.00	242-C	2.375	1.375	1.375	19	63.62	225	26	13.5	11.75	8	0.750	3/4-10 UNC	32.0	12.0
	9.00	242-B						300					0.750		42.3	14.5
	9.00	242-HB						225					0.750		55.4	14.5
	10.00	242-C						225					0.750		43.4	15.0
10	12.00	242-A	2.375	1.375	1.375	15	103.87	225	26	16.0	14.25	12	0.750	7/8-9 UNC	44.0	15.2
	12.00	242-HB						225					0.750		43.8	15.4
	13.00	242-HA						300					0.750		57.5	15.4
	14.00	242-C						225					0.750		46.0	16.0
12	12.00	242-B	2.375	1.375	1.375	13	137.89	225	26	19.0	17.00	12	0.875	7/8-9 UNC	64.1	23.5
	12.00	242-HB						275					0.875		86.5	23.5
	13.00	242-A						225					0.875		65.5	24.5
	13.00	242-HA						275					0.875		88.4	24.5
14	14.00	242-C	2.375	1.375	1.375	13	137.89	275	26	19.0	17.00	12	0.875	7/8-9 UNC	66.7	24.5
	12.00	242-B						225					0.875		66.7	24.5
	12.00	242-HB						275					0.875		88.4	24.5
	13.00	242-A						225					0.875		66.7	24.5
16	12.00	242-B	1.750	1.118	1.118	9	182.65	150	26	19.0	18.75	12	1.000	—	110.0	30.5
	12.00	242-HB						150					1.000		112.0	32.0
	13.75	242-A						200					1.000		144.0	32.0
	13.75	242-HA						200					1.000		144.0	32.0
18	12.00	242-B	1.750	1.118	1.118	8	240.53	125	26	23.5	21.25	16	1.000	—	124.0	28.8
	12.00	242-HB						175					1.000		160.0	28.8
	13.75	242-A						125					1.000		132.0	30.8
	13.75	242-HA						175					1.000		170.2	30.8
20	12.00	242-B	1.750	1.118	1.118	7	298.65	125	26	25.0	22.75	16	1.125	—	138.0	35.1
	13.75	242-HB						125					1.125		146.0	36.1
	13.75	242-A						175					1.125		181.2	36.1
	13.75	242-HA						175					1.125		181.2	36.1
22	12.00	242-B	1.750	1.118	1.118	6	433.74	125	26	27.5	25.0	20	1.125	—	172.0	35.0
	13.75	242-HB						125					1.125		182.0	35.5
	13.75	242-A						175					1.125		182.0	35.5
	13.75	242-HA						175					1.125		182.0	35.5
24	12.00	242-C	1.750	1.118	1.118	5	510.70	110	26	32.5	29.5	20	1.125	—	190.0	47.0
26	13.75	242-A	1.750	1.118	1.118	5	593.96	110	26	34.25	31.75	24	1.125	—	220.0	48.0
	13.75	242-HA						160					1.125		266.2	48.0
	13.75	242-C						160					1.125		266.2	48.0
30	12.00	242-C	1.750	1.118	1.118	4	779.31	110	26	38.75	36.0	28	1.125	—	270.0	62.0

control units

Spec. 24.06

Table 4: Control Units/Unanchored

Control Units must be installed when pressures (test • design • surge • operating) exceed rating below:

Pipe Size	Series 240 P.S.I.G.	Series 242 P.S.I.G.
1" thru 4"	180	135
5" thru 10"	135	135
12" thru 14"	90	90
16" thru 24"	45	45
26" thru 30"	35	35

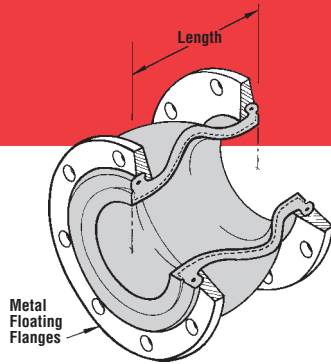


Figure 1.
Style 240
Single Sphere Connector

Table 5: Control Units

Control Rod Plate O.D. ¹ (in)	Control Rod Plate Thickness (in)	Rod Diameter ² (in)	Nominal Pipe Size (in)	Maximum Surge or Test Pressure of System/PSIG ³		
				Number of Rods Required:		
				2	3	4
8.375	0.375	0.625	1	949	—	—
8.750	0.375	0.625	1.25	830	—	—
9.125	0.375	0.625	1.5	510	—	—
10.125	0.375	0.625	2	661	—	—
11.125	0.375	1.000	2.5	529	—	—
11.625	0.375	1.000	3	441	—	—
12.625	0.375	1.000	3.5	365	547	729
13.125	0.375	1.000	4	311	467	622
14.125	0.500	1.000	5	235	353	470
15.125	0.500	1.000	6	186	278	371
19.125	0.500	1.000	8	163	244	326
21.625	0.750	1.000	10	163	244	325
24.625	0.750	1.000	12	160	240	320
26.625	0.750	1.000	14	112	167	223
30.125	0.750	1.250	16	113	170	227
31.625	0.750	1.250	18	94	141	187
34.125	0.750	1.250	20	79	118	158
36.125	1.000	1.250	22	85	128	171
38.625	1.000	1.250	24	74	110	147
40.825	1.000	1.250	26	62	93	124
44.125	1.250	1.500	28	65	98	130
46.375	1.250	1.500	30	70	105	141

NOTES: 1. Control Rod Plate O.D. installed dimension is based on a maximum O.D. PROCO would supply. (See Figures 3 & 4)
2. Control Rod diameter is based on a maximum diameter PROCO would use to design a Control Rod.
3. Rod pressure ratings are based on metal conforming to F.S.A. standards and dimensions.

Table 6: Special Construction Pressures

Pipe Size	Series 240 & 242 Heavyweight P.S.I.G.
1" thru 8"	300
10" thru 12"	275
14"	200
16" thru 20"	175
22" thru 30"	160

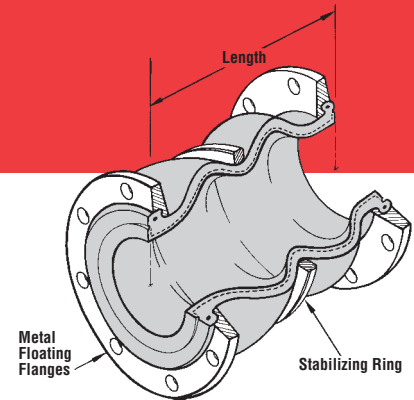
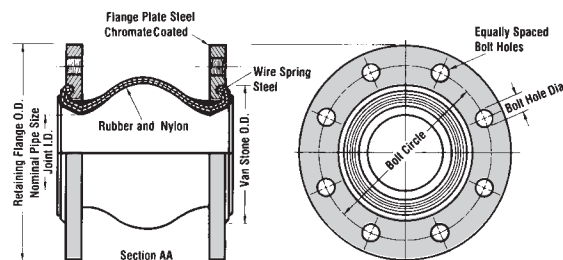


Figure 2.
Style 242
Twin Sphere Connector

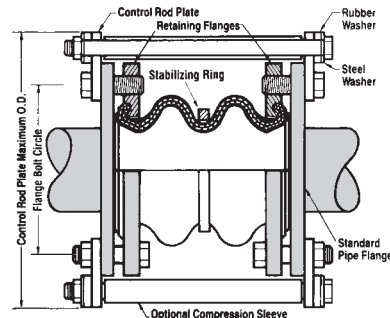
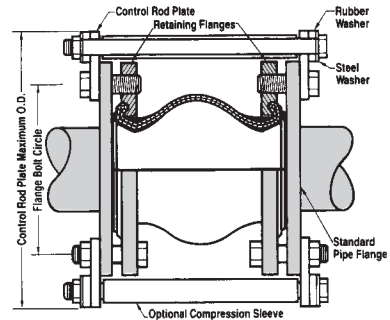
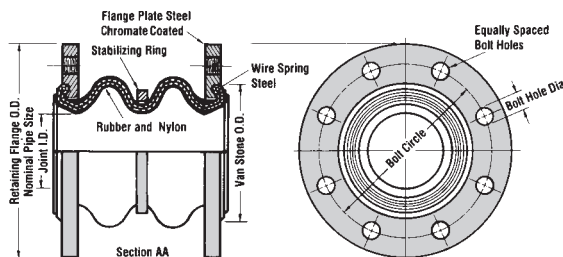
Style 240 Single Sphere Connector

Figure 3.



Style 242 Twin Sphere Connector

Figure 4.



Control Rod/Unit Applications. Control unit assemblies are designed to absorb static pressure thrust developed at the expansion joint. When used in this manner, control unit assemblies are an additional safety factor, minimizing possible failure of the expansion joint or damage to equipment. (See Tables 4 & 5).

- 1. Anchored Systems:** Control unit assemblies are not required in piping systems that are anchored on both sides of the expansion joint, provided piping movements are within the rated movements as shown in Tables 2 & 3.
- 2. Unanchored Systems:** Control unit assemblies are always required in unanchored systems. Additionally, control unit assemblies must be used when maximum pressure exceeds the limits shown in Table 4 & 5, or the movement exceeds the rated movements as shown in Tables 2 & 3.

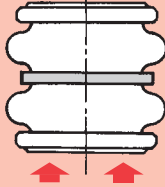
- 3. Spring-Mounted Equipment:** Control unit assemblies are always recommended for spring-mounted equipment. Additionally, control unit assemblies must be used when maximum pressure exceeds the limits shown in Tables 4 & 5, or the movement exceeds the rated movements as shown in Tables 2 & 3.

Special Applications. Certain Style 240 (Single Sphere) and 242 (Twin Sphere) expansion joints are available in High-Pressure Designs. For specific pressures, see Table 6. Style designations are listed as 240-HW (sizes stocked in Table 2) and 242-HA, 242-HB & 242-HC (sizes stocked in Table 3.) The High-Pressure Design is recommended when the connector is to be installed into ANSI 250/300# piping systems.

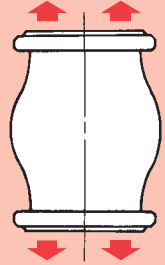
drilling for series 240 and series 242 expansion joints

Table 7: Flange Drilling

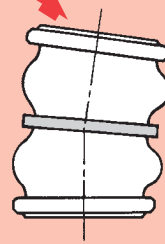
NOMINAL PIPE SIZE Inch/ mm	American 125/150# Conforms to ANSI B16.1 and B16.5					American 250/300# Conforms to ANSI B16.1 and B16.5					British Standard 10:1902 Conforms to BS 10 Table E					Metric Series Conforms to I.S.O. 2084-1974 Table NP10 Holes to I.S.O. /R-273					Metric Series Conforms to I.S.O. 2084-1974 Table NP16 Holes to I.S.O. /R-273				
	Flange Thickness	Flange O.D.	Bolt Circle	No. of Holes	Drilled Hole Size	Threaded Hole Size	Flange Thickness	Flange O.D.	Bolt Circle	No. of Holes	Hole Size	Flange Thickness	Flange O.D.	Bolt Circle	No. of Holes	Flange Thickness	Flange O.D.	Bolt Circle	No. of Holes	Hole Size	Flange Thickness	Flange O.D.	Bolt Circle	No. of Holes	Hole Size
1 25	0.55 14.0	4.25 108.0	3.13 79.4	4	0.62	1/2 - 13 UNC	0.63 16.0	4.88 124.0	3.5 88.9	4	0.75 19.1	0.59 15.0	4.5 114.0	3.25 82.6	4	0.62 15.9	4.5 114.0	3.25 82.6	4	0.62 15.9	0.63 16.0	4.53 115.0	3.35 85.0	4	0.55 14.0
1.25 32	0.55 14.0	4.63 118.0	3.5 88.9	4	0.62	1/2 - 13 UNC	0.63 16.0	5.25 133.0	3.88 98.4	4	0.75 19.1	0.59 15.0	4.75 121.0	3.44 87.3	4	0.62 15.9	4.75 121.0	3.44 87.3	4	0.71 18.0	0.63 16.0	5.51 140.0	3.94 100.0	4	0.71 18.0
1.5 40	0.55 14.0	5.0 127.0	3.88 98.4	4	0.62	1/2 - 13 UNC	0.63 16.0	6.12 156.0	4.50 114.3	4	0.88 22.2	0.59 15.0	5.25 133.0	3.88 98.4	4	0.62 15.9	5.25 133.0	3.88 98.4	4	0.71 18.0	0.63 16.0	5.91 150.0	4.33 110.0	4	0.71 18.0
2 50	0.63 16.0	6.0 152.0	4.75 120.7	4	0.75	5/8 - 11 UNC	0.71 18.0	6.50 165.0	5.00 127.0	8	0.75 19.1	0.63 16.0	6.0 152.0	4.5 114.3	4	0.75 19.1	0.71 18.0	4.92 125.0	4	0.71 18.0	0.71 18.0	6.50 165.0	4.92 125.0	4	0.71 18.0
2.5 65	0.71 18.0	7.0 178.0	5.5 139.7	4	0.75	5/8 - 11 UNC	0.71 18.0	7.5 191.0	5.88 149.2	8	0.88 22.2	0.71 18.0	6.5 165.0	5.0 127.0	4	0.75 19.1	0.71 18.0	5.71 145.0	4	0.71 18.0	0.71 18.0	7.28 185.0	5.71 145.0	4	0.71 18.0
3 80	0.71 18.0	7.5 191.0	6.0 152.4	4	0.75	5/8 - 11 UNC	0.79 20.0	8.25 210.0	6.62 168.2	8	0.88 22.2	0.71 18.0	7.25 184.0	5.75 146.1	4	0.75 19.1	0.79 20.0	6.3 160.0	8	0.71 18.0	0.79 20.0	7.87 200.0	6.30 160.0	8	0.71 18.0
3.5 90	0.71 18.0	8.5 216.0	7.0 177.8	8	0.75	5/8 - 11 UNC	0.79 20.0	9.0 229.0	7.25 184.2	8	0.88 22.2	0.71 18.0	8.0 203.0	6.5 165.1	8	0.75 19.1	—	—	—	—	—	—	—	—	—
4 100	0.71 18.0	9.0 229.0	7.5 190.5	8	0.75	5/8 - 11 UNC	0.79 20.0	10.0 254.0	7.88 200.0	8	0.88 22.2	0.71 18.0	8.5 216.0	7.0 177.8	8	0.75 19.1	0.79 20.0	7.09 180.0	8	0.71 18.0	0.79 20.0	8.66 220.0	7.09 180.0	8	0.71 18.0
5 125	0.79 20.0	10.0 254.0	8.5 215.9	8	0.88	3/4 - 10 UNC	0.87 22.0	11.0 279.0	9.25 235.0	8	0.88 22.2	0.79 20.0	10.0 254.0	8.25 209.6	8	0.75 19.1	0.87 22.0	9.84 250.0	8	0.71 18.0	0.87 22.0	9.84 250.0	8.27 210.0	8	0.71 18.0
6 150	0.87 22.0	11.0 279.0	9.5 241.3	8	0.88	3/4 - 10 UNC	0.87 22.2	12.5 318.0	10.62 269.9	12	0.88 22.2	0.87 22.2	11.0 279.0	9.25 235.0	8	0.88 22.2	0.87 22.0	11.22 285.0	8	0.87 22.0	0.87 22.0	11.22 285.0	9.45 240.0	8	0.87 22.0
8 200	0.87 22.0	13.5 343.0	11.75 298.5	8	0.88	3/4 - 10 UNC	0.95 24.0	15.0 381.0	13.0 330.2	12	1.00 25.4	0.87 22.2	13.25 337.0	11.5 292.1	8	0.88 22.2	0.87 22.0	13.39 340.0	8	0.87 22.0	0.87 22.0	13.39 340.0	11.61 295.0	12	0.87 22.0
10 250	0.95 24.0	16.0 406.0	14.25 362.0	12	1.00	7/8 - 9 UNC	1.02 26.0	17.5 445.0	15.25 387.4	16	1.13 28.6	0.95 24.0	11.60 406.0	14.0 355.6	12	0.88 22.2	1.02 26.0	15.55 395.0	12	0.87 22.0	1.02 26.0	15.94 405.0	13.98 355.0	12	1.02 26.0
12 300	0.95 24.0	19.0 483.0	17.0 431.8	12	1.00	7/8 - 9 UNC	1.02 26.0	20.5 521.0	17.75 450.9	16	1.25 31.8	0.95 24.0	18.0 457.0	16.0 406.4	12	1.00 25.4	1.02 26.0	17.52 445.0	12	0.87 22.0	1.02 26.0	18.11 460.0	16.14 410.0	12	1.02 26.0
14 350	1.02 26.0	21.0 533.0	18.75 476.3	12	1.13	1 - 8 UNC	1.10 28.0	23.0 584.0	20.25 514.4	20	1.25 31.8	1.02 26.0	20.75 527.0	18.5 469.9	12	1.00 25.4	1.10 28.0	19.88 505.0	16	0.87 22.0	1.10 28.0	20.47 520.0	18.50 470.0	16	1.02 26.0
16 400	1.10 28.0	23.5 597.0	21.25 539.8	16	1.13	1 - 8 UNC	1.18 30.0	25.5 648.0	22.5 571.5	20	1.38 34.9	1.10 28.0	22.75 578.0	20.5 520.7	12	1.00 25.4	1.18 30.0	22.24 565.0	16	1.02 26.0	1.18 30.0	22.83 580.0	20.67 525.0	16	1.18 30.0
18 450	1.18 30.0	25.0 635.0	22.75 577.9	16	1.25	1 1/8 - 7 UNC	1.18 30.0	28.0 711.0	24.75 628.7	24	1.38 34.9	1.18 30.0	25.25 641.0	23.0 584.2	16	1.00 25.4	1.18 30.0	24.21 615.0	20	1.02 26.0	1.18 30.0	25.20 640.0	23.03 585.0	20	1.18 30.0
20 500	1.18 30.0	27.5 699.0	25.0 635.0	20	1.25	1 1/8 - 7 UNC	1.18 30.0	30.5 775.0	27.0 685.8	24	1.38 34.9	1.18 30.0	27.75 705.0	25.25 641.4	16	1.00 25.4	1.18 30.0	26.38 670.0	20	1.02 26.0	1.18 30.0	28.15 715.0	25.59 650.0	20	1.30 33.0
22 550	1.18 30.0	29.5 749.0	27.25 692.2	20	1.38	1 1/4 - 7 UNC	1.18 30.0	33.0 838.0	29.5 743.0	24	1.38 34.9	1.18 30.0	30.0 762.0	27.5 698.5	16	1.13 28.6	1.18 30.0	28.74 730.0	20	1.18 30.0	1.18 30.0	30.51 775.0	27.95 710.0	20	1.30 33.0
24 600	1.18 30.0	32.06 813.0	29.5 749.3	20	1.38	1 1/4 - 7 UNC	1.18 30.0	36.0 914.0	32.0 812.8	24	1.62 41.3	1.18 30.0	32.5 826.0	29.75 755.7	16	1.25 31.8	1.18 30.0	30.71 780.0	20	1.18 30.0	1.18 30.0	33.07 840.0	30.31 770.0	20	1.42 36.0
26 650	1.26 32.0	34.25 870.0	31.75 806.5	24	1.38	1 1/4 - 7 UNC	1.26 32.0	38.25 972.0	34.5 876.0	28	1.75 44.5	—	—	—	—	—	1.26 32.0	32.87 835.0	24	1.18 30.0	1.26 32.0	33.86 860.0	31.10 790.0	24	1.42 36.0
30 750	1.26 32.0	38.75 984.0	36.0 914.4	28	1.38	1 1/4 - 7 UNC	1.26 32.0	43.0 1092.0	39.25 997.0	28	2.00 50.8	1.26 32.0	39.25 997.0	36.5 927.1	20	1.38 34.9	1.26 32.0	37.99 965.0	24	1.30 33.0	1.26 32.0	38.19 970.0	35.43 900.0	24	1.42 36.0



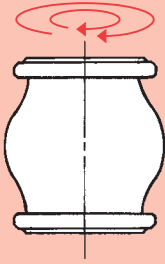
Axial Compression



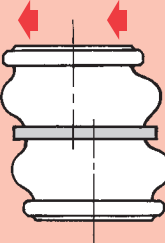
Axial Elongation



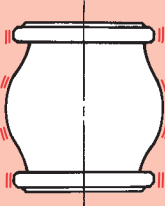
Angular Movement
Bending About the Centerline



Torsional Movement
Rotation About the Centerline (twist)



Lateral Movement
Shear or Perpendicular to Centerline



Absorbing Vibration

Spec. 24.06

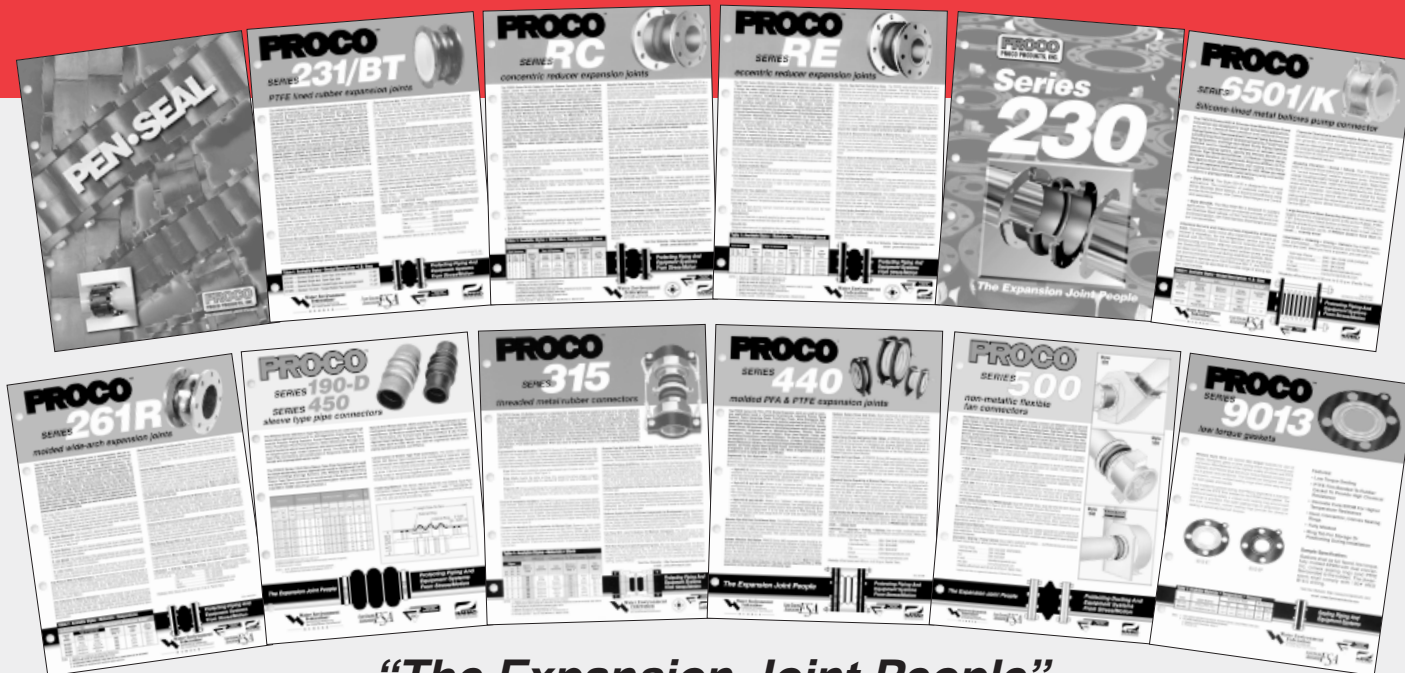
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Spec. 24.06

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Warning: Expansion joints may operate in pipelines or equipment carrying fluids and/or gases at elevated temperatures and pressures. Normal precautions should be taken to make sure these parts are installed correctly and inspected regularly. Precautions should be taken to protect personnel in the event of leakage or splash. Note: Piping must be properly aligned and anchored to prevent damage to an expansion joint. Movement must not exceed specified ratings and control units are always recommended to prevent damage in the event other anchoring in the system fails. Properties applications shown throughout this data sheet are typical. This information does not constitute a warranty or representation and we assume no legal responsibility or obligation with respect thereto and the use to which such information may be put. Your specific application should not be undertaken without independent study and evaluation for suitability.

	HOSE FITTINGS MATERIAL SPECIFICATION	SPEC NO:
	UNIVERSAL HOSE COUPLING - MALLEABLE IRON	32.40

SAP PART NUMBER:

CCC DRAWING NUMBER:

MATERIAL: Universal Hose Coupling, Malleable iron, male pipe thread on one end with other end for connecting to universal coupling.

RATING: 90 psig @ 140 DEG. F.

MANUFACTURER: Chicago Pneumatic, or equal.

SIZES: 1/4" - C-36844Y

3/8" - C-36843Y

1/2" - C-36842Y

3/4" - C-36841Y

1" - C-36840Y

NOTE: Above model number includes one standard type rubber gasket No. C-101158Y for air service. For water service use neoprene gasket No. C-101160Y.

Issue Date:

Revision Date:

Approved by Joseph P. McMahon on 10/30/98



UNIVERSAL COUPLINGS



MALE NPT



Ductile Iron

npt size	part number	list each
3/8	UM-38	6.88
1/2	UM-2	5.72
3/4	UM-3	6.09
1	UM-4	6.83



Brass

3/8	UMB-38	—
1/2	UMB-2	—
3/4	UMB-3	—
1	UMB-4	—

316 Stainless

1/2	UMSS-2	44.71
3/4	UMSS-3	38.75
1	UMSS-4	41.73

UNIVERSALOCK™
COUPLINGS

HOSE END

Ductile Iron
(machined serrations)

hose size	part number	list each
3/8	UH-38	7.98
1/2	UH-2	4.99
5/8	UH-58	7.61
3/4	UH-3	5.15
1	UH-4	6.88

Brass

(machined serrations)

3/8	UHB-38	—
1/2	UHB-2	12.60
5/8	UHB-58	—
3/4	UHB-3	14.49
1	UHB-4	18.59

316 Stainless

(machined serrations)

1/2	UHSS-2	43.47
3/4	UHSS-3	36.71
1	UHSS-4	40.57

BLANK END



Ductile Iron

size	part number	list each
All	UB	9.82

Brass

All	UBB	—
-----	-----	---

THREE WAY



Ductile Iron

size	part number	list each
All	UTW	17.85

Brass

All	UTWB	—
-----	------	---

UNIVERSAL WASHER



Nitrile

size	part number	list each
All	UG	0.53

Never use Universal Washers
in UniversaLock Couplings

SAFETY CLIP



size	part number	list each
All	SC	0.26

TWO-BOLT
UNIVERSAL CLAMP

Ductile Iron

hose o.d. min to max	part no.	list each
3/4 to 15/16	UC-2	5.78
1 to 1-1/4	UC-3	5.83
1-1/4 to 1-17/32	UC-4	10.08

DISTRIBUTOR AUTHORIZATION

Safety is of paramount concern to every-one. Due to the volatile nature of compressed air, and in accordance with our ISO 9000 quality system, we reserve the right to restrict sales of our UniversaLock® Couplings to only those distributors authorized by Campbell Fittings.

Please contact our customer service department for more information.

HOSE END



Ductile Iron

(machined serrations)

hose size	part number	list each
1/2	ULH-2	19.10
3/4	ULH-3	19.10
1	ULH-4	19.10

MALE END



Ductile Iron

(machined serrations)

npt size	part number	list each
1/2	ULM-2	19.10
3/4	ULM-3	19.10
1	ULM-4	19.10

FEMALE END



Ductile Iron

(machined serrations)

npt size	part number	list each
1/2	ULF-2	19.10
3/4	ULF-3	19.10

UNIVERSALOCK WASHER



Nitrile

size	part number	list each
All	ULW	2.13

Never use UniversalLock Washers
in standard Universal Couplings

FEMALE NPT



Ductile Iron


npt size	part number	list each
3/8	UF-38	6.88
1/2	UF-2	6.30
3/4	UF-3	5.93
1	UF-4	7.72

Brass

3/8	UFB-38	—
1/2	UFB-2	—
3/4	UFB-3	—
1	UFB-4	—

316 Stainless

1/2	UFSS-2	44.71
3/4	UFSS-3	38.75
1	UFSS-4	41.73

	HOSE FITTINGS MATERIAL SPECIFICATION	SPEC NO:
	QUICK DISCONNECT MALE ADAPTER - ALUMINUM	32.60

SAP PART NUMBER:

CCC DRAWING NUMBER:

MATERIAL: Quick disconnect male adapter, Aluminum, male NPT on one end with other end for connecting to quick disconnect female coupler.

RATING: 150 psig @ 100 DEG. F.

MANUFACTURER: Dixon, Ever-Tite

SIZES: 1/2" thru 4"

MODELS: Dixon "Andrews" line, type F, Ever-Tite Part F, or equal.

Issue Date: 04/16/90 Revision Date: 09/15/99

Approved by Matthew R. McGowan on 09/27/99

www.callapg.com

713-675-5271
1-800-888-5223FAX 713-675-2730
FAX 1-800-444-3252

Cam and Groove Couplings

Part F

Male Adapter x Male Thread
-NPT Standard
-BSP, BST, & NPSM Available

EVER-TITE® Premium Cam and Groove Couplings				
Size	Aluminum	Forged Brass	316 Stainless Steel	Polypropylene
1/2"	305FAL	305FBR	305FSS	*305FPP
3/4"	307FAL	307FBR	307FSS	307FPP
1"	310FAL	310FBR	310FSS	310FPP
1-1/4"	312FAL	312FBR	312FSS	312FPP
1-1/2"	315FAL	315EBR	315FSS	315FPP
2"	320FAL	320FBR	320FSS	320FPP
2-1/2"	325FAL	325FBR	325FSS	—
3"	330FAL	330FBR	330FSS	330FPP
4"	340FAL	340FBR	340FSS	340FPP
5"	350FAL	†350FRB	350FSS	—
6"	360FAL	†360FRB	360FSS	—
8"	ΔΔ380FAL	—	—	—



EVER-TITE® Couplings also Available in
Hard Coat or Anodized Aluminum
Monel, Hastalloy C, and Carpenter 20®

†5" and 6" are Red Brass.

* on 1/2" size, the coupler and adapter portion is to the 3/4" standard.

° on 1-1/4" size, the coupler and adapter portion is to the 1-1/2" standard.

ΔΔ 8" Part is compatible with Dixon "Andrews" and NECO.

Tough-TITE™ Industrial Cam and Groove Couplings						
Size	Aluminum	Brass	316 Stainless Steel	Ductile Iron	Nylon	Polypropylene
1/2"	3E05FAL	3E05FCB	3E05FSS	—	*3E05FNY	*3E05FPP
3/4"	3E07FAL	3E07FCB	3E07FSS	—	3E07FNY	3E07FPP
1"	3E10FAL	3E10FCB	3E10FSS	—	3E10FNY	3E10FPP
1-1/4"	3E12FAL	3E12FCB	3E12FSS	—	°3E12FNY	°3E12FPP
1-1/2"	3E15FAL	3E15FCB	3E15FSS	3E15FDI	3E15FNY	3E15FPP
2"	3E20FAL	3E20FCB	3E20FSS	3E20FDI	3E20FNY	3E20FPP
2-1/2"	3E25FAL	3E25FCB	3E25FSS	—	—	—
3"	3E30FAL	3E30FCB	3E30FSS	3E30FDI	3E30FNY	3E30FPP
4"	3E40FAL	3E40FCB	3E40FSS	3E40FDI	3E40FNY	3E40FPP
5"	3E50FAL	3E50FCB	—	—	—	—
6"	3E60FAL	3E60FCB	3E60FSS	—	—	—
8"	ΔΔ3E80FALA	—	—	—	—	—



* on 1/2" size, the coupler and adapter portion is to the 3/4" standard.


° on 1-1/4" size, the coupler and adapter portion is to the 1-1/2" standard.

ΔΔ 8" Part is compatible with Dixon "Andrews" and NECO.

U-TITE Utility Cam and Groove Couplings		
Size	Aluminum	316 Stainless Steel
1-1/2"	3U15FAL	3U15FSS
2"	3U20FAL	3U20FSS
3"	3U30FAL	3U30FSS
4"	3U40FAL	3U40FSS



Note: If a dash (-) appears in lieu of a published part number, please inquire regarding current availability.

	HOSE FITTINGS MATERIAL SPECIFICATION	SPEC NO:
	QUICK DISCONNECT FEMALE COUPLER - ALUMINUM	32.61

SAP PART NUMBER:

CCC DRAWING NUMBER:

MATERIAL: Quick disconnect female coupler, Aluminum, Buna-N gaskets, male NPT on one end with other end for connecting to quick disconnect male adapter.

RATING: 150 psig @ 100 DEG. F.

MANUFACTURER: Dixon, Ever-Tite

SIZES: 1/2" thru 4"

MODELS: Dixon "Andrews" line - type B, Ever-Tite Part B, or equal.

Issue Date: 07/16/92 Revision Date: 09/15/99

Approved by Matthew R. McGowan on 09/27/99

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FAX 1-800-444-3252

Cam and Groove Couplings

Part B

Female Coupler x Male Thread

- NPT Standard
- BSP & BST Available

EVER-TITE® Premium Cam and Groove Couplings				
Size	Aluminum	Forged Brass	316 Stainless Steel	Polypropylene (Stainless Steel Handles)
1/2"	305BAL	305BBR	305BSS	*305BPP
3/4"	307BAL	307BBR	307BSS	307BPP
1"	310BAL	310BBR	310BSS	310BPP
1-1/4"	312BAL	312BBR	312BSS	°312BPP
1-1/2"	315BAL	315BBR	315BSS	315BPP
2"	320BAL	320BBR	320BSS	320BPP
2-1/2"	325BAL	325BBR	325BSS	—
3"	330BAL	330BBR	330BSS	330BPP
4"	340BAL	340BBR	340BSS	340BPP
5"	350BAL	†350BRB	350BSS	—
6"	360BAL	†360BRB	360BSS	—
8"	ΔΔ380BAL	—	—	—



Investment Cast Stainless Steel Handles
Standard on EVER-TITE® Aluminum
Couplers (Brass Handles Available)

EVER-TITE® Couplings also Available in
Hard Coat or Anodized Aluminum,
Monel, Hastalloy C, and Carpenter 20®

†5" and 6" are Red Brass.

* on 1/2" size, the coupler and adapter portion is to the 3/4" standard.

° on 1-1/4" size, the coupler and adapter portion is to the 1-1/2" standard.

ΔΔ 8" Part has 4-handle design and is compatible with Dixon "Andrews" and NECO

Tough-TITE™ Industrial Cam and Groove Couplings						
Size	Aluminum	Brass	316 Stainless Steel	Ductile Iron	Nylon (Stainless Steel Handles)	Polypropylene (Stainless Steel Handles)
1/2"	3E05BAL	3E05BCB	3E05BSS	—	*3E05BNY	*3E05BPP
3/4"	3E07BAL	3E07BCB	3E07BSS	—	3E07BNY	3E07BPP
1"	3E10BAL	3E10BCB	3E10BSS	—	3E10BNY	3E10BPP
1-1/4"	3E12BAL	3E12BCB	3E12BSS	—	°3E12BNY	°3E12BPP
1-1/2"	3E15BAL	3E15BCB	3E15BSS	3E15BDI	3E15BNY	3E15BPP
2"	3E20BAL	3E20BCB	3E20BSS	3E20BDI	3E20BNY	3E20BPP
2-1/2"	3E25BAL	3E25BCB	3E25BSS	—	—	—
3"	3E30BAL	3E30BCB	3E30BSS	3E30BDI	3E30BNY	3E30BPP
4"	3E40BAL	3E40BCB	3E40BSS	3E40BDI	3E40BNY	3E40BPP
5"	3E50BAL	3E50BCB	—	—	—	—
6"	3E60BAL	3E60BCB	3E60BSS	—	—	—
8"	—	—	—	—	—	—



Brass Handles Standard
on Tough-Tite™ Aluminum
Couplers

* on 1/2" size, the coupler and adapter portion is to the 3/4" standard.


° on 1-1/4" size, the coupler and adapter portion is to the 1-1/2" standard.

U-TITE Utility Cam and Groove Couplings		
Size	Aluminum	316 Stainless Steel
1-1/2"	3U15BAL	3U15BSS
2"	3U20BAL	3U20BSS
3"	3U30BAL	3U30BSS
4"	3U40BAL	3U40BSS



Brass Handles Standard on U-TITE Aluminum Couplers

Note: If a dash (-) appears in lieu of a published part number, please inquire regarding current availability.

	PRESSURE INDICATING GAGES MATERIAL SPECIFICATION	SPEC NO:
	PI-213 TO PI-218; PI-448 TO PI-560	IS008

SAP PART NUMBER:

CCC DRAWING NUMBER:

MATERIAL: As listed below:

Case:	4-1/2" size, stainless steel, steel, brass, aluminum and phenol.
Socket:	1/2" NPT male bottom connection, stainless steel.
Dial:	White litho with black figures.
Pointer:	Balanced micrometer.
Bourdon Tube:	Stainless steel.
Movement:	Stainless steel and Delrin.
Accuracy:	1% of full range.
Liquid Fill:	None

RATING: Temperature range of -4 DEG. F. to +150 DEG. F.

MANUFACTURER: Ashcroft, WIKA

MODELS: Ashcroft "Duragauge" - 1279, WIKA 232.34

NOTES: As listed below:

1. Spec. IS008 replaces Spec. No. 7209A-CS263
2. This specification replaces the Specs. listed below.

RANGE: As listed below:

ITEM NO.	SCALE RANGE	REPLACES THESE ITEMS	
PI-213	0-15 PSIG	PI-101,7	SPEC. No. 7209A-CS161,2 (IS001,2)
PI-214	0-30 PSIG	PI-102,8	SPEC. No. 7209A-CS161,2 (IS001,2)
PI-215	0-60 PSIG	PI-103,9	SPEC. No. 7209A-CS161,2 (IS001,2)
PI-216	0-100 PSIG	PI-104,10	SPEC. No. 7209A-CS161,2 (IS001,2)
→ PI-217	0-160 PSIG	PI-105,11	SPEC. No. 7209A-CS161,2 (IS001,2)
PI-218	0-200 PSIG	PI-106,12	SPEC. No. 7209A-CS161,2 (IS001,2)
PI-448	0-300 PSIG		
PI-557	0-300 PSIG *		
PI-449	0-400 PSIG		
PI-556	0-400 PSIG *		
PI-450	0-800 PSIG		
PI-558	0-800 PSIG *		
PI-559	0-1500 PSIG		
PI-560	0-1500 PSIG *		*With Steam Coil Siphon

GENERAL REQUIREMENTS:



Bourdon Tube Pressure Gauges

Solid-Front Turret Style Thermoplastic Case

4½" & 6" Process Industry Series
316SS Wetted Parts • Type 23X.34

Pressure Gauges

Application

Industrial type suitable for corrosive environments where the fluid medium does not clog connection or corrode wetted part material. Field convertible to a liquid filled gauge for severe vibration conditions. Solid front, blow-out back case design meets safety requirements of ASME B40.1.

Size

4½" (115mm) & 6" (152 mm) dial size

Accuracy

± 0.5% of span (ASME B40.1 Grade 2A)

Ranges

Vacuum / Compound to 30"HG / 0 / 400 PSI
Pressure from 15 PSI to 30,000 PSI
or other equivalent units of pressure or vacuum
Receiver scale: 3...15psi

Working Range

Steady: Full scale value
Fluctuating: 0.9 x full scale value
Short time: 1.5 x full scale value

Operating Temperature

Ambient: -40°F to 150°F (-40°C to 65.6°C) ^{Note 1}

Media: 212°F - max.
**500°F - dry gauge (intermittent) Optional
**250°F - Liquid filled (intermittent) Optional
**300°F - Dampened Movement (4½" only)

Temperature Error

Additional error when temperature changes from reference temperature of 68°F (20°C), approximately ±1.5% per 100°F (55.5°C Δ T) rising or falling. Percentage of span.

Standard Features

Connection

Material: 316 stainless steel
Lower mount (LM) + Lower back mount (LBM)
1/4" NPT and 1/2" NPT have M4 internal tap - STD.

Bourdon Tube

Material: 316 stainless steel
30" Hg (Vac) to 1000 PSI C-type
1500 PSI to 10,000 PSI helical type

Movement

Stainless steel
Internal stop pin at 1.3 times full scale value
Overload and underload stops- standard
Optional: dampened movement

Shock & Vibration

Shock resistance up to 100G
Optional: up to 400G
Optional: vibration resistance up to 10G

Cycle Testing

400,000-2,000,000*cycles, depending upon pressure range (4½" only)

*liquid filled

Dial

White aluminum with black lettering. Stop pin at 6 o'clock



Pointer

Adjustable black all

Case

Black glass reinforced thermoplastic (PBTP)
Solid front, blow-out back
Turret style case with built in rear flange lugs

Weather Protection

Weather resistant (NEMA 3 / IP 54) - dry case
Weather tight (NEMA 4X / IP 65) - liquid-filled case

Standard Scale

PSI
Receiver scales 0/100% linear, 0/10 sq.rt.

Window Gasket

Buna-N

Window

Acrylic

Case Filling

None - 232.34
Glycerine - 233.34
Dampened movement - 239.34

Order Options (min. order may apply)

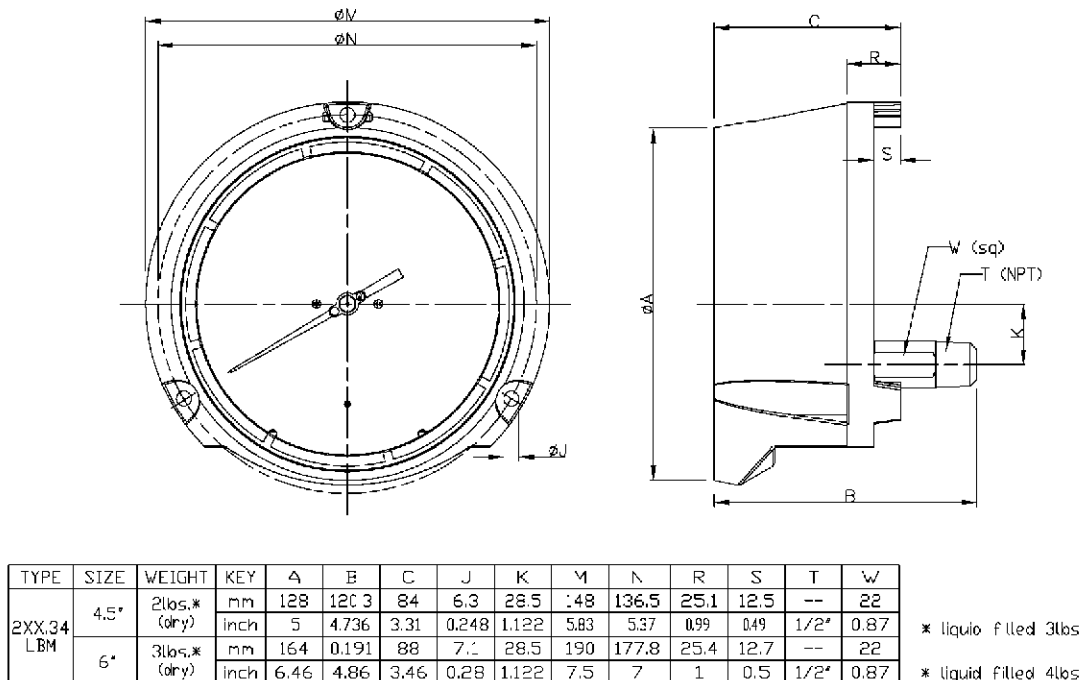
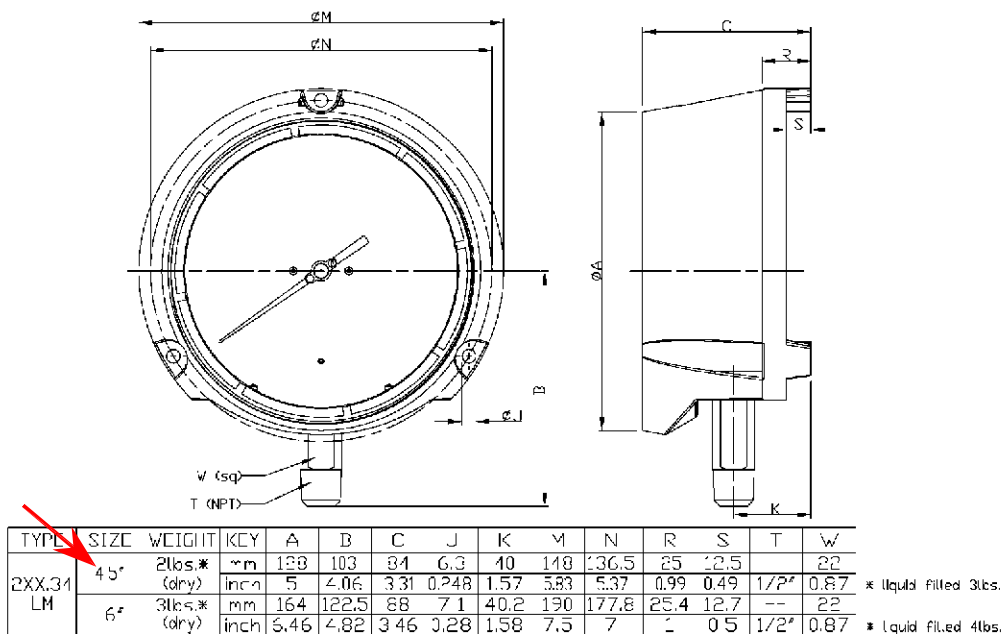
Overpressure protection up to 5x scale (limited ranges only)
Threaded restrictor
Silicone dampened movement
Panel mounting adaptor kit (field assembled) (4½" only)
Movement with PTFE coated gears
Glycerine, silicone, or fluorolube case filling ^{Note 1}
Field conversion kit for glycerine, silicone, or fluorolube fill
Cleaned for oxygen service
Glass window
Safety glass window
Externally adjustable red drag pointer (max. hand) (4½" only)
Externally adjustable red mark pointer (4½" only)
Special connections limited to socket square size
DIN standards
Custom dial layout
Other pressure scales available:
Bar, kPa, MPa, Kg/cm², and dual scales
Alarm contact switches (4½" only)
Shock resistant up to 400G
Vibration resistant up to 10G
Luminescent dial (4½" only)
Alloy steel socket connection (4½" only)
Chemical seals available

^{Note 1} Temperature Ranges (Liquid filled gauges)
Glycerine: -4°F to 150°F (-20°C to 65.6°C)
Silicone: -40°F to 150°F (-40°C to 65.6°C)

APM 23X.34
(Apm 02.10)

Dimensions:

Spec. PI-217



****Technical Note:** Maximum continuous media temperatures of 212°F is recommended. Maximum temperatures shown are for intermittent, short term exposure. User should consider temperature error and gauge component degradation when exposing gauge to any media or ambient temperature above 140 °F. For continuous use in either ambient or media temperatures above 140 °F, a diaphragm seal or other heat dissipating means is recommended. Consult factory for technical inquiries and application assistance.

Ordering Information:

State computer part number (if available) / type number / size / range / connection size and location / options required.

Specifications given in this price list represent the state of engineering at the time of printing. Modifications may take place and the specified materials may change without prior notice

WIKAI


WIKA Instrument Corporation

1000 Wiegand Boulevard

Lawrenceville, Georgia 30043-5868

Tel: 770-513-8200 Fax: 770-338-5118

<http://www.wika.com> e-mail: info@wika.com

	RUPTURE DISKS MATERIAL SPECIFICATION	SPEC NO:
	PSE-155 TO PSE-157;PSE-252;PSE-301 TO PSE-306;PSE-577;PSE-580	IS015

SAP PART NUMBER:

CCC DRAWING NUMBER:

MATERIAL: Impervious graphite.

Type: Standard.

Vacuum Support: Furnish for disks with bursting pressure of 15 psig or less.

FLANGES: 150 # ANSI RF or FF companion flanges (furnished by others)

MANUFACTURER: Zook, or equal.

SIZES: As listed below:

ITEM NO.	SIZE	BURSTING PRESSURE
PSE-155	1"	75 PSIG +/- 5%
PSE-156	1-1/2"	75 PSIG +/- 5%
PSE-157	2"	75 PSIG +/- 5%
PSE-170	2"	125 PSIG +/- 5%
PSE-252	3"	75 PSIG +/- 5%
PSE-301	3"	35 PSIG +/- 5%
PSE-302	3"	50 PSIG +/- 5%
PSE-303	3"	65 PSIG +/- 5%
PSE-304	3"	87 PSIG +/- 5%
PSE-305	3"	150 PSIG +/- 5%
PSE-306	3"	75 PSIG +/- 5%
PSE-307	3"	100 PSIG +/- 5%
PSE-577	3"	125 PSIG +/- 5%
PSE-580	4"	125 PSIG +/- 5%

SPECIFICATIONS: ASME UD stamp required.

NOTES: As listed below:

1 - Tag with Item No. and Service.

2 - IS015 replaces Spec. No. 7209a-CS172

SERVICE CONDITIONS:

As listed below:

Fluid Under Disks:	Water
Pressure Fluctuation:	Back Pressure:
Temperature:	40 to 150 degrees F.
Operating Pressure:	80% of bursting pressure.
Back Pressure:	Atmospheric.

GENERAL REQUIREMENTS:

As listed Below:

Bursting Pressure:	See table above
Coincident Temperature:	150 degrees F.
Relieving Capacity:	In accordance with ASME

Issue Date: 04/06/90 Revision Date: 09/10/2007

Approved by Joseph P. McMahon on 09/10/2007



BS&B SAFETY SYSTEMS, L.L.C.
BS&B SAFETY SYSTEMS LTD

SAF-T-GRAF



**Saf-T-Graf graphite disks are
impermeable to process
gases and fluids**

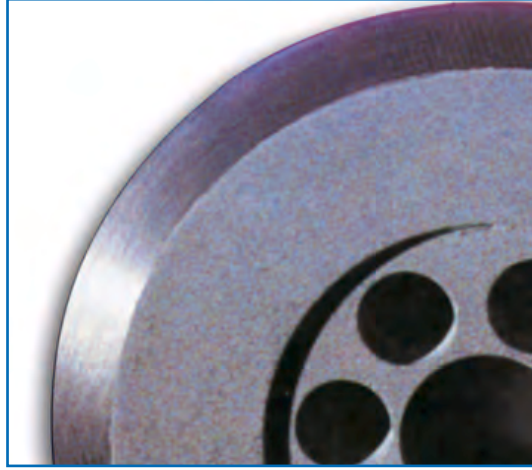
SAF-T-GRAF® FEATURES

- ♦ Offers superior sealing characteristics to process gases and fluids
- ♦ Corrosion resistant (except free fluorine)
- ♦ Burst pressures from 0.02 bar (0.25 psig) to 69 bar (1000 psig)
- ♦ Higher operating temperature than other impregnated graphite disks up to 205°C (400°F)
- ♦ Full bore opening
- ♦ Sizes from 15 to 600 mm (0.5" to 24" and larger)
- ♦ Extended service life for operating pressures up to 80% of the disk marked pressure in a static environment - Lower operating ratios can be expected in a cyclic environment
- ♦ Suitable for gas service and liquid service
- ♦ Supplied with gaskets attached for immediate installation.
- ♦ Resists full vacuum (vacuum support required below 1.52 bar (22 psig) burst pressure)
- ♦ Optional PTFE coating to reduce product build-up
- ♦ Graphite impregnation is environmentally safe
- ♦ Patent pending
- ♦ ASME code, UD stamp above 15 psig (1.03 barg) available

SAF-T-GRAF® System

Armor

Armor is recommended for all graphite disks for added safety, easier installation and elimination of breakage during installation. Armor reduces the possibility of a premature burst due to uneven or excessive torquing of the flange studs.



Armor is standard on disks with burst pressures in excess of 150 psig or to fit ANSI Class 300/600 flanges. Carbon steel armor is standard with 304/316 Stainless Steel as an option.

Saf-T-Graf monobloc impregnated graphite disks. Vacuum supports are designed utilizing the latest computer software to maximize venting capacities while maintaining structural strength. Armor ring around disk's circumference shown left.

Disks for Immediate Shipment

In order to provide the best possible service, BS&B stocks monobloc disks in the following sizes: 25, 40, 50, 80, 100, 150 and 200 mm (1", 1.5", 2", 3", 4", 6", 8").

Stocked Burst Pressures:

10-15-20-25-30-40-50-75-100-125-150 psig

All disks must be for 150 ANSI flange ratings.

Flange Ratings

Saf-T-Graf disks can be supplied to fit flange ratings ANSI, DIN, JIS, BS, AFNOR etc. Please specify flange rating when ordering

Gaskets

BS&B Safety Systems, L.L.C. stocks gaskets in the materials below:

- ♦ Garlock® or Klinger®-Sil (standard)

Optional Materials:

- ♦ GRAFOIL®
- ♦ Neoprene
- ♦ PTFE solid

Please specify your gasket material when ordering.

Sensors

A GAS™ (Graphite Alert Sensor) is available to provide warning of a burst graphite disk

Installations

The Saf-T-Graf disk is designed to permit direct installation between ANSI, DIN, JIS, BS, AFNOR pipe flanges and to locate between the flange bolts.

Operating Ratio

Up to 80% operating pressure to burst pressure ratio in a static environment. Lower operating ratios can be expected in a cyclic environment.

Klinger®-Sil is a registered trade mark of Klinger (Holdings) Ltd.

Garlock® is a registered trade mark of Coltec Industries

GRAFOIL® is a registered trade mark of UCAR Carbon Company, Inc.

Monobloc

Spec. IS015 Item PSE-577

Model MB™

Monobloc disks fit most applications where a graphite disk is needed.

When using a monobloc disk in application:

- ♦ Vacuum supports are needed for disks rated below 1.52 bar (22 psig) and where a vacuum condition exists. Model MBVTM.
- ♦ Vacuum supports are not needed for sizes 15 and 20 mm (0.5", .75").
- ♦ Temperature ranges -730 C to 205°C (-100°F to 400°F).
- ♦ Armoring is recommended for all graphite disks for added safety, easier installation and elimination of breakage during installation
- ♦ Armor reduces the possibility of a premature burst due to uneven or excessive torquing of the flange studs



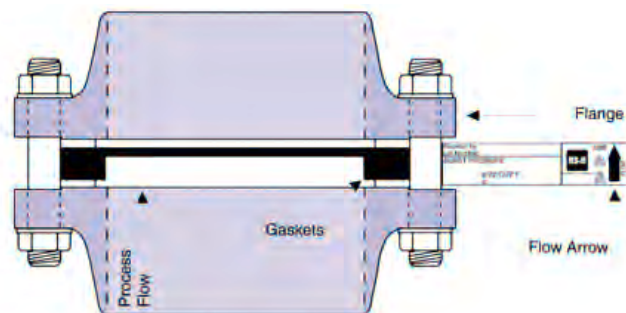
Model MBV (with bar) and MB.

MB™ Specifications

Nominal Size		Burst Ratings				Internal Diameter		Disk Thickness	
		Barg		PSIG					
mm	in	Min	Max	Min	Max	mm	in	mm	in
15	0.5	1.73	10.3	25	150	15.9	0.625	16	0.625
20	0.75	1.73	10.3	25	150	21	0.825	16	0.625
25	1	0.69	10.3	10	150	27.2	1.07	22	0.875
40	1.5	0.49	10.3	7	150	41.1	1.62	22	0.875
50	2	0.14	10.3	2	150	52.6	2.07	22	0.875
80	3	0.069	10.3	1	150	78.0	3.07	22	0.875
100	4	0.069	10.3	1	150	103.4	4.07	22	0.875
150	6	0.069	10.3	1	150	154.2	6.07	22	0.875
200	8	0.035	10.3	0.5	150	205.0	8.07	29	1.125
250	10	0.0173	8.6	0.25	125	255.8	10.07	38	1.50
300	12	0.0173	8.6	0.25	125	306.6	12.07	51	2.00
350	14	0.0173	6.89	0.25	100	336.5	13.25	57	2.25
400	16	0.0173	6.89	0.25	100	387.4	15.25	64	2.50
450	18	0.0173	6.89	0.25	100	438.2	17.25	70	2.75
500	20	0.0173	3.4	0.25	50	489.0	19.25	76	3.00
600	24	0.0173	3.4	0.25	50	590.6	23.25	76	3.00

For other disk thickness, contact BS&B Safety Systems, L.L.C. or BS&B Safety Systems LTD.

MB



MB monobloc disks are available in size from 15mm to 600 mm (0.5" to 24") with a temperature range to 205° C (400°F).

(For Venting Capacities Chart please refer to page 5.)

Burst Pressure - 125 psig

Differential Pressure Gauges Type 1131 2% Ascending Accuracy

- Rolling diaphragm actuator
- Stainless steel case
- Ranges from 5 psid-100 psid
- Static pressures up to 3000 psi
- Aluminum⁽³⁾, brass or stainless steel bodies⁽¹⁾
- Buna-N O-rings (others available)
- Superior magnets for smoother power motion
- Standard or explosion-proof reed switches available
- 5-year warranty

The Type 1131 is utilized for applications where migration of the process media is not permissible. The Type 1131 uses a rolling diaphragm design to separate the high and low-pressure ports to isolate the media and can see up to 3000 psi static pressures. Body materials are available in Aluminum, Brass and Stainless Steel, with Buna, Viton or EPDM seals.⁽²⁾

- (1) Not for use with incompatible media.
 (2) Other wetted parts include stainless steel, Teflon and ceramic.
 (3) Not to be used with water or corrosive applications.



SPECIFICATIONS	Type 1131
Accuracy (Ascending)	2%
Migration	Zero
Range Limits	0-5 psid to 100 psid
Maximum Static Pressure	3000 psi (all)
Actuator	Rolling Diaphragm
Case Material	Stainless Steel
Dial Size	2 1/2" (25), 3 1/2" (36), 4" (40), 4 1/2" (45), 6" (60)
Maximum Process Temperature	175°F / 80°C
Body Materials	Aluminum (F), Brass (A), Stainless Steel (S)
Diaphragm/O-Rings	Buna-N
Connection Size (Female)	1/8 NPT (RQ), 1/4 NPT (25)
Connection Location	In-Line (S), Lower (L), Back (B)
Window	Glass
Warranty	Five Years
OPTIONS	
Switches ⁽¹⁾	Available
Front Flange (XFF)	Available
Viton Seals/O-Rings (XVD)	Available
EPDM Seals/O-Rings (XEM)	Available
Glycerin Fill (L)	Standard Fill Option
Silicone Fill (XGV)	Available
Plastic Window (XPD)	Available
Explosion Proof (XEK)	Available ⁽²⁾

- (1) Applicable to Switches
 (XV1) 1 SPST with DIN Plug (XV5) 1 SPDT with DIN Plug
 (XV2) 1 SPST with Terminal Strip (XV6) 1 SPDT with Terminal Strip
 (XV3) 2 SPST with DIN Plug (XV7) 2 SPDT with DIN Plug
 (XV4) 2 SPST with Terminal Strip (XV8) 2 SPDT with Terminal Strip

- (2) Specify lower or back connection for gauge (not available in-line) and switch type XV1-XV8

RATINGS FOR BOTH STANDARD & EXPLOSION PROOF SWITCHES:

SPST SWITCH

Specifications:

- Contact Rating
10 VA ac (rms) or dc (max)
Switching Current
0.5 Amp ac (rms) or dc (max)
Switch Voltage
150 Vac/Vdc (max)

SPDT SWITCH

Specifications:

- Contact Rating
~~5 VA ac (rms) or dc (max)~~
Switching Current
~~0.25 Amp ac (rms) or dc (max)~~
Switch Voltage
~~175 Vac/Vdc (max)~~

EXPLOSION-PROOF SWITCH INFORMATION:

Switches and electrical connections are mounted in an explosion-proof enclosure with UL, CSA, Cenelec and FM approval. The enclosure meets Class 1, Groups B, C, D, Class 2 Groups E, F, G, Class 3, NEMA 7 & 9 and IP 66. Two 3/4" electrical conduit connections.

STANDARD RANGES – Type 1131

psi	0-5	0-7	0-15	0-25	0-30	0-40	0-60	0-100
kPa	0-25	0-50	0-75	0-100	0-200	0-250	0-400	0-700
Kg/cm ² -Bar	0-0.25	0-0.5	0-0.75	0-1	0-2	0-2.5	0-4	0-7

TO ORDER THIS 1131 DIFFERENTIAL PRESSURE GAUGES:

Select: _____ 25 1131 FD 25S XXX 30 psid

1. Dial size— 2 1/2", 3 1/2", 4", 4 1/2", 6" _____

2. Case type—1131 _____

3. Body material _____

4. Connection size—1/8 NPTF (RQ), 1/4 NPTF (25) _____

5. Connection location—In-line (S), Lower (L), Back (B) _____

6. Optional features—see above _____

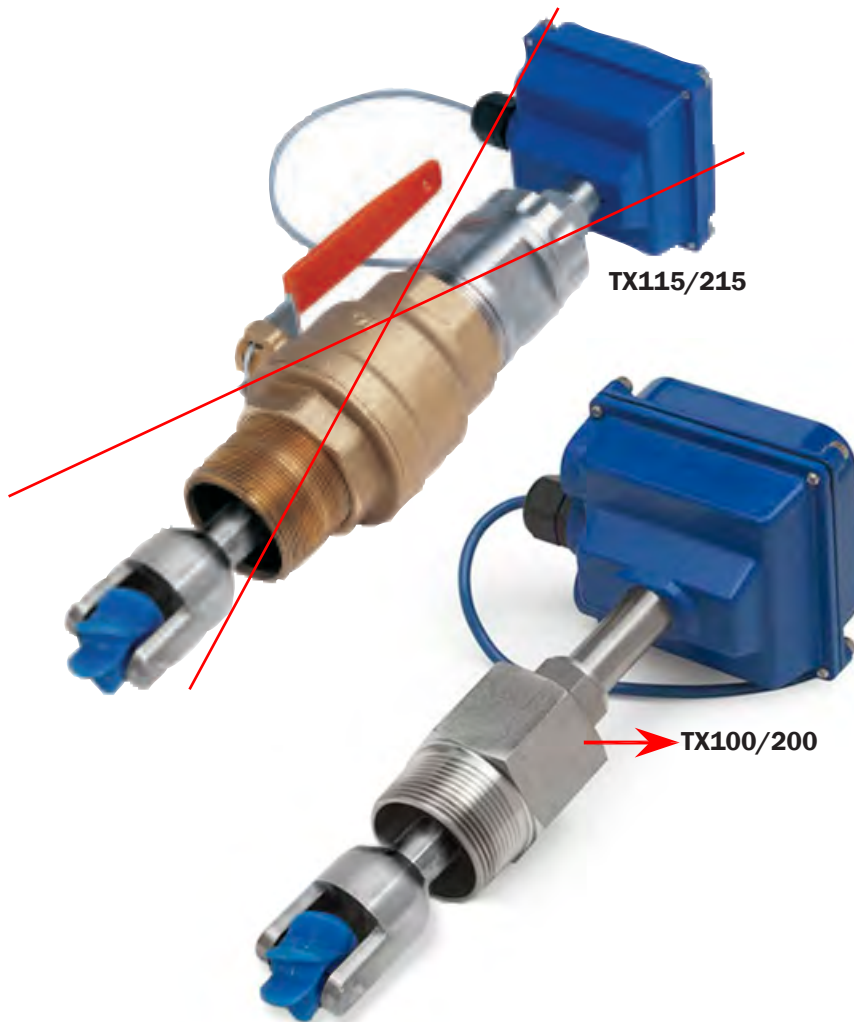
7. Standard pressure range _____

FEATURES

- Wide flow range
- One moving part
- Hot tap available
- Modular electronics compatible
- Easily depth adjustable for 3-40" pipe

APPLICATIONS

- Clean water
- Large pipes
- Aquariums, water parks
- Water & wastewater monitoring



GENERAL INFORMATION

The TX100/200-Series are adjustable depth insertion turbines that come in ~~brass~~ or 316 stainless models to fit 3" to 40" pipe. Installation fittings are standard 1-1/2" (101/201) ~~or 2" (115/215)~~ FNPT. Fittings such as saddles and weldolets may be purchased either locally or from Seametrics.

Ruby bearings and a non-drag pickoff give these adjustable insertion turbine flow sensors a wide flow range and long life. A sensor detects the passage of miniature magnets in the rotor blades. The resulting square-wave signal can be sent for hundreds of feet without a transmitter, over unshielded cable. This signal can be connected directly to many PLC's and other controls without any additional electronics.

If desired, a modular system of electronics can be installed directly on the flow sensor or mounted remotely. The FT415 (battery powered) ~~or FT420 (loop powered)~~ provides digital rate and total display, as well as programmable pulse; ~~the FT420 also provides a 4-20 mA analog output. The AO55 is a blind analog (4-20 mA) transmitter. Programmable pulse for pump~~ ~~pacing is available with the PD10.~~

~~The "hot tap" models (TX115/215) can be installed or serviced without shutting down the line by means of a 2" full-port isolation valve that comes with a nipple for installation on the pipe fitting. In most circumstances, no special tool is required.~~

FEATURES

Modular electronics (optional)

- rate/total/pulse/4-20 mA
- blind 4-20 transmitter
- pulse divider

18 Foot Cable

Rugged cast aluminum housing

Compression nut
for easy adjustment, secure locking

Adapter fitting
with 1-1/2" NPT threads

Rotor housing

Removable jewel bearings
Rotor

TX101/201

3/4" diameter tubing
for low insertion force

2" Adapter
removes to mount
hot-tap machine

Full-port 2" ball valve
for sensor removal

Adapter fitting
with 2" NPT threads

Locking collar

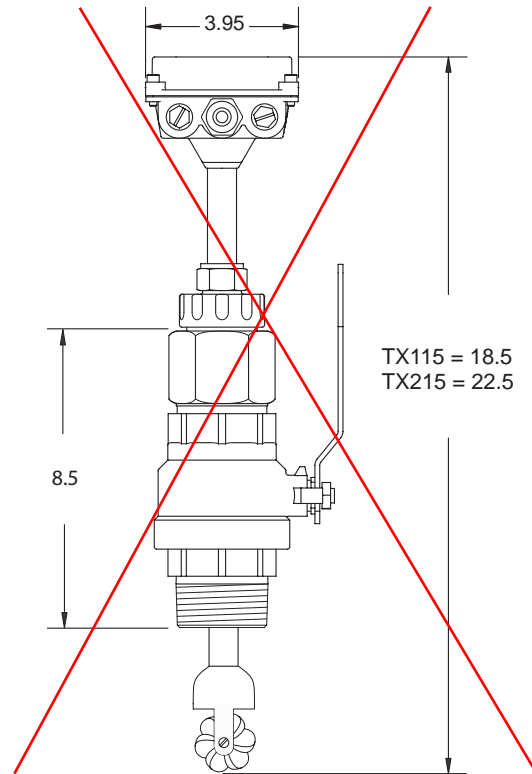
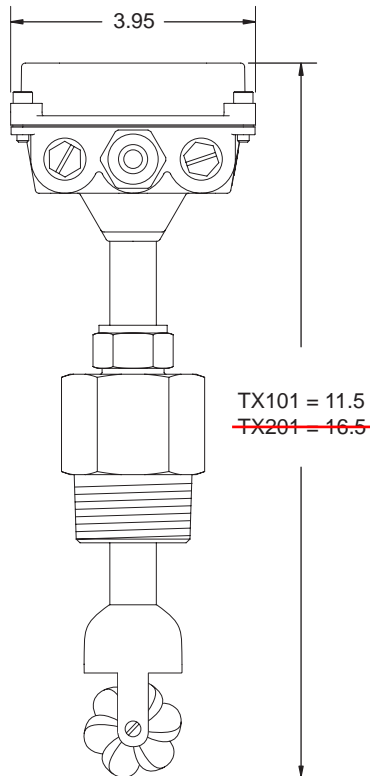
TX115/215

SPECIFICATIONS*

Power Source		Standard	Micropowered (-04 Option)
Supply Voltage/Current		6-40 Vdc / < 2 mA	3.5-16 Vdc / 60 µA @ 3.5 Vdc
Sensor	Type	Magnetoresistive	Magnetoresistive
	Output	Current Sinking Pulse	Current Sinking Pulse
	Sinking Current	100 mA max	2 mA max
	External Pull-up Resistor	3-40 Vdc	≤ Supply Voltage
Pipe Size		TX101/115 3" - 12" (50 - 300mm)	TX201/215 12" - 40" (300 - 1000mm)
Materials	Housing	Cast aluminum	
	Sensor Body	Brass or 316 SS	
	Rotor	PVDF standard	
	Shaft/Bearings	Nickel-bound tungsten carbide/Ruby	
	Isolation Valve	TX101/201 None	TX115/215 Bronze (316SS optional)
Fitting Size		1-1/2" NPT	2" NPT
Flow Range		0.5 - 30 feet/sec (0.15 - 9.14 meter/sec)	
Accuracy		+/-1.5% of full scale	
Maximum Temperature		200° F (93° C)	
Maximum Pressure		200 psi (14 bar)	
Insertion Force		0.44 x pressure in pipe	
Cable		#22 AWG 3-con, 18' (6m); 2,000' (650m) maximum cable run	
Regulatory		CE Mark (Standard Power Only)	

*Specifications subject to change. Please consult our website for the most current data (www.seametrics.com).

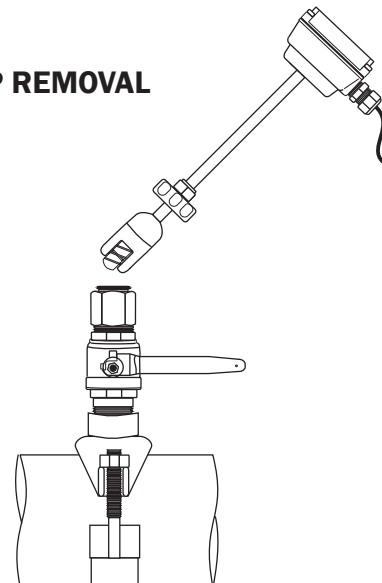
DIMENSIONS



HOT TAP INSTALLATION

Insertion and removal under pressure is possible due to the 2" full-port isolation valve, which comes with a nipple for installation on the pipe fitting. If it is necessary to do the initial installation under pressure, any standard hot tap drilling machine with 2" NPT adapter, such as a Transmate or a Mueller, can be used. Ordinarily, it is not necessary to use an installation tool, since the small-diameter tube can be controlled by hand at all but the highest pressures.

HOT TAP REMOVAL



FLOW RANGE (Gallons Per Minute)

Pipe Size	3"	4"	6" → 8"	10"	12"	16"	18"	24"	30"	36"	40"	
Min.	11.5	19.8	45	78	123	176	313	396	704	1,100	1,585	1,960
Max.	691	1,190	2,700	4,680	7,370	10,470	16,520	20,900	37,600	62,505	87,410	117,500

Approximations based on Schedule 40 pipe.



TX100/200-SERIES Insertion Turbine Flow Sensor

HOW TO ORDER

MODEL	MATERIAL	OPTIONS
3" - 12" = TX101	Brass = B	Adapter Fitting, 2" Threads = -02
3" - 12" Hot tap = TX115	316 Stainless = S	Bi-Directional = -03
12" - 40" = TX201		Micropower Pickup (FT415 & DL76 Only) = -04
12" - 40" Hot tap = TX215		LMI Pump Connector = -06
		Seametrics Control Connector = -07
		Stainless Valve Assembly (115/215 only) = -08
		No Valve Assembly (115/215 only) = -09
		*Immersibility = -40
		12" Extension (200-Series only) = -72
		Consult factory for suitable applications

ACCESSORIES
Rate & Total Indicator w/4-20 mA Output = FT420
Battery Operated Rate/Totalizer = FT415
Blind 4-20 mA Transmitter = AO55
Power Supply = PC3
Data Logger = DL76
Pulse Divider = PD10
Saddle Fittings = Consult Factory

CONTACT YOUR SUPPLIER

TX100/200-SERIES

Seametrics

INSERTION TURBINE INSTRUCTIONS



TX101/201



TX115/215

TX100/200-SERIES INSERTION TURBINE INSTRUCTIONS

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GENERAL INFORMATION

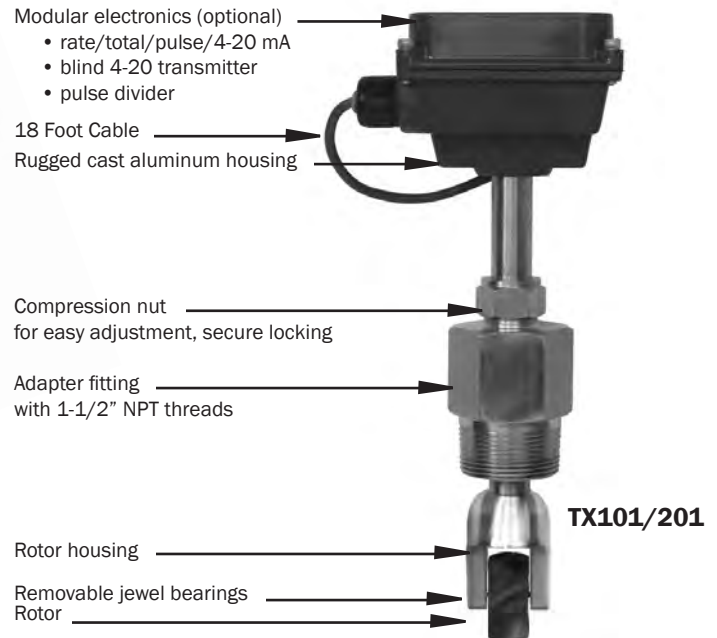
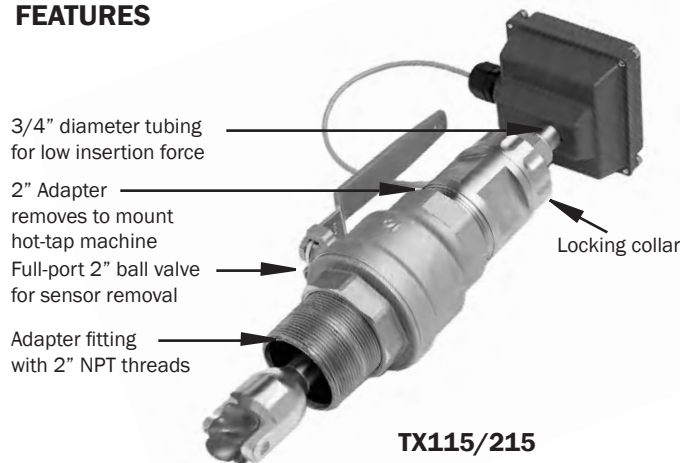
The TX100/200-Series are adjustable depth insertion turbines that come in brass or 316 stainless models to fit 3" to 40" pipe. Installation fittings are standard 1-1/2" (101/201) or 2" (115/215) FNPT. Fittings such as saddles and weldolets may be purchased either locally or from Seametrics.

Ruby bearings and a non-drag pickoff give these adjustable insertion turbine flow sensors a wide flow range and long life. A sensor detects the passage of miniature magnets in the rotor blades. The resulting square-wave signal can be sent for hundreds of feet without a transmitter, over unshielded cable. This signal can be connected directly to many PLC's and other controls without any additional electronics.

If desired, a modular system of electronics can be installed directly on the flow sensor or mounted remotely. The FT415 (battery powered) or FT420 (loop powered) provides digital rate and total display, as well as programmable pulse; the FT420 also provides a 4-20 mA analog output. The AO55 is a blind analog (4-20 mA) transmitter. Programmable pulse for pump pacing is available with the PD10.

The "hot-tap" models (TX115/215) can be installed or serviced without shutting down the line by means of a 2" full-port isolation valve that comes with a nipple for installation on the pipe fitting. In most circumstances, no special tool is required.

FEATURES



SPECIFICATIONS*

Power Source		Standard	Micropowered (-04 Option)
Supply Voltage/Current		6-40 Vdc/< 2 mA	3.5-16 Vdc/60 µA @ 3.5 Vdc
Sensor	Type	Magnetoresistive	Magnetoresistive
	Output	Current Sinking Pulse	Current Sinking Pulse
	Sinking Current	100 mA max	2 mA max
	External Pull-up Resistor	3-40 Vdc	≤ Supply Voltage
Pipe Size		TX101/115 3" - 12" (50 - 300mm)	TX201/215 12" - 40" (300 - 890mm) <small>Note: For larger pipe sizes contact factory</small>
Materials	Housing	Cast aluminum	
	Sensor Body	Brass or 316 SS	
	Rotor	PVDF standard	
	Shaft/Bearings	Nickel-bound tungsten carbide/Ruby	
	Isolation Valve		
		TX101/201 None	TX115/215 Bronze (316SS optional)
Fitting Size		1-1/2" NPT	2" NPT
Flow Range		0.5 - 30 feet/sec (0.15 - 9.14 meter/sec)	
Accuracy		±1.5% of full scale	
Maximum Temperature		200° F (93° C)	
Maximum Pressure		200 psi (14 bar)	
Insertion Force		0.44 x pressure in pipe	
Cable		#22 AWG 3-con, 18' (6m); 2,000' (650m) maximum cable run	
Regulatory		CE Mark (Standard Power Only)	

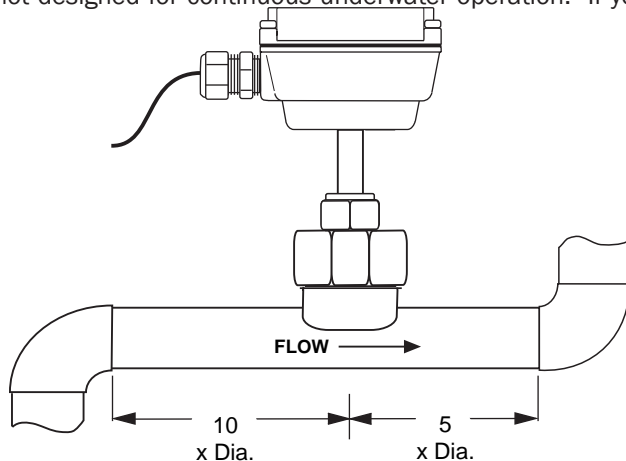
*Specifications subject to change. Please consult our website for the most current data (www.seametrics.com).

INSTALLATION

An insertion flow sensor measures the velocity of flow at one point in the pipe; flow rate and total can be inferred from this one point. Accuracy is decreased by any factor which makes the flow at the measured point unrepresentative of the entire flow stream. This includes distorted flow patterns caused by upstream fittings too close to the sensor. The worst offenders are fittings that increase the flow on one side of the pipe, such as partially-opened gate or butterfly valves. Fluid moving in a pipe does not flow at the same velocity. Toward the center of the pipe, fluid moves faster than at the wall, and the relationship between the two changes as overall flow rate increases. This change in the “velocity profile” can result in non-linearity, which means that the K-factor (see page 7) that is correct for one flow rate may be incorrect for another. Recommended depth settings (see page 6) have been carefully chosen to minimize this source of error, and should be followed carefully, especially in the smaller pipe sizes.

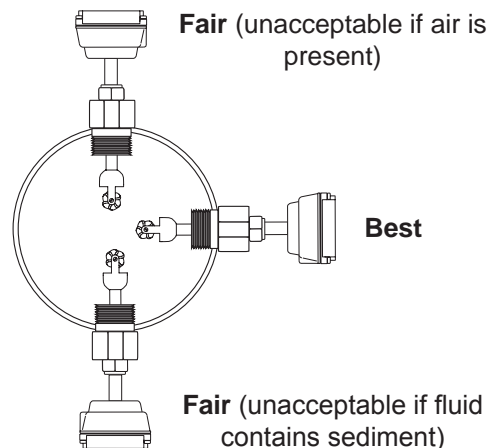
Piping. For best results, the TX sensor should be installed with at least ten diameters of straight pipe upstream and five downstream. Certain extreme situations such as partially-opened valves are particularly difficult and may require more straight diameters upstream. See Straight Pipe and Full Pipe recommendations on following pages.

Immersion. The TX100/200-Series standard sensors are not designed for continuous underwater operation. If your



meter may experience occasional temporary immersion, as in a flooded vault, a unit modified for immersion should be specified (Option -40).

Positioning the Meter. Horizontal is the preferred installation orientation, since it improves low-flow performance slightly and avoids problems with trapped air. Bottom, top, and vertical pipe installations are all acceptable if required by the piping layout.

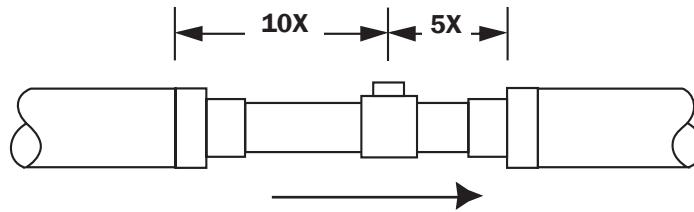


CAUTION: These water meters are not recommended for installation downstream of the boiler feedwater pump where installation fault may expose the meter to boiler pressure and temperature. Maximum recommended temperature is 200°F.

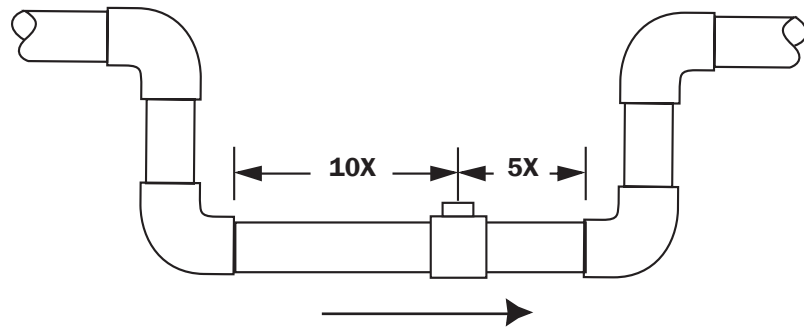
STRAIGHT PIPE RECOMMENDATIONS

(X = diameter)

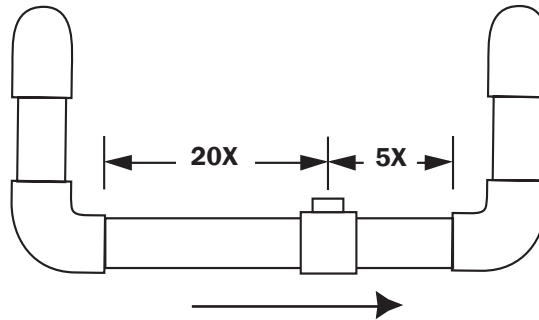
Reduced Pipe



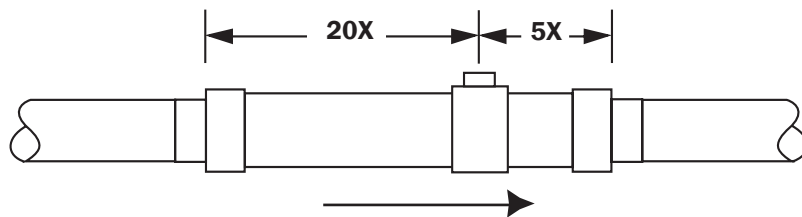
Two Elbows In Plane



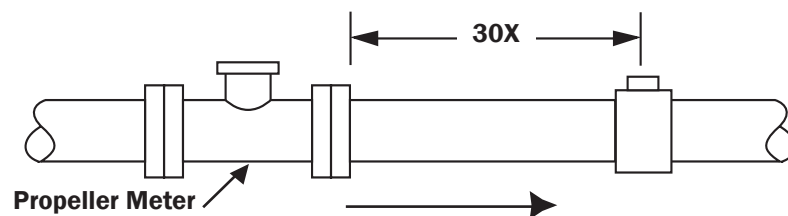
Two Elbows, Out Of Plane



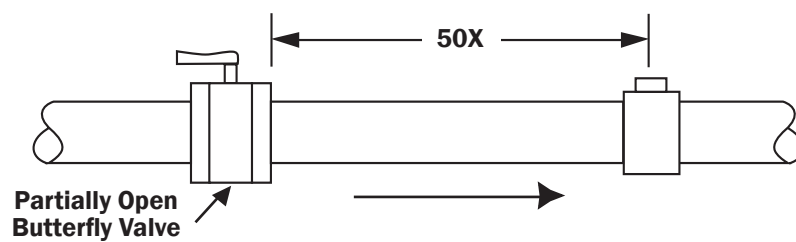
Expanded Pipe



Spiral Flow

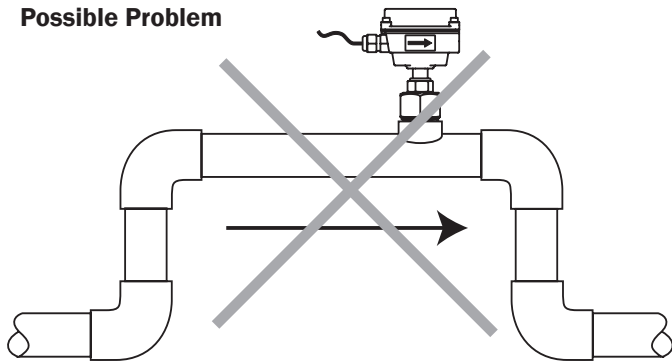


Swirling Flow



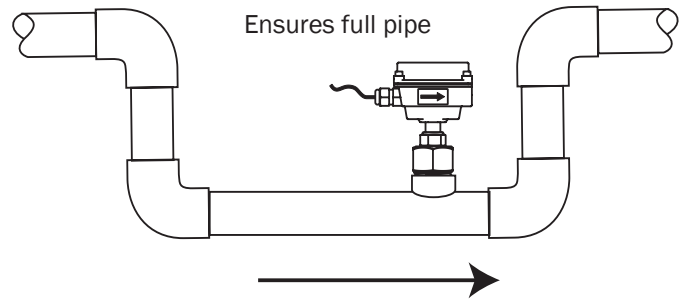
FULL PIPE RECOMMENDATIONS

Possible Problem

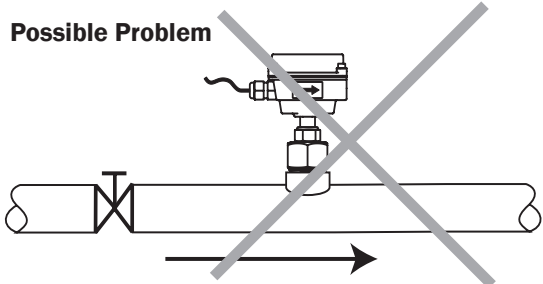


Allows air pockets to form at sensor

Better Installation

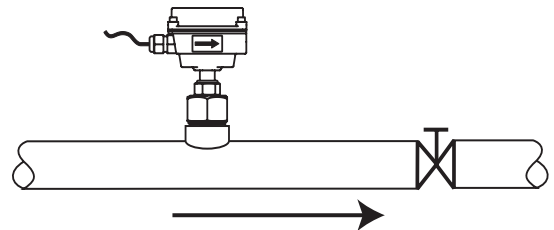


Possible Problem



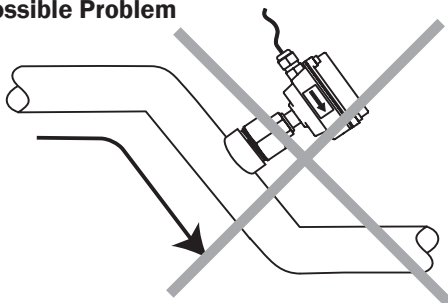
Post-valve cavitation can create air pocket

Better Installation



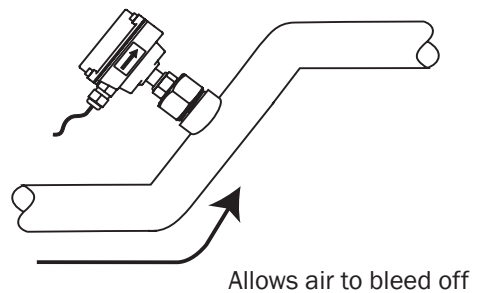
Keeps pipe full at sensor

Possible Problem



Air can be trapped

Better Installation



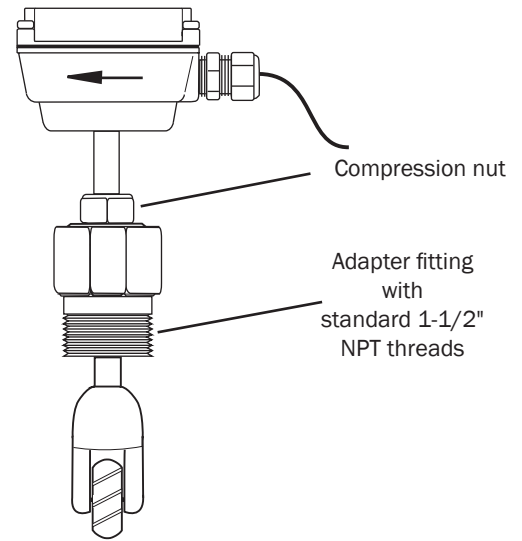
Allows air to bleed off

INSTALLATION

TX101/201 INSTALLATION

Fitting Installation. TX101/201 sensors come with a 1-1/2" male NPT pipe thread adapter fitting. Any fitting that provides the matching NPT female thread may be used. Installation procedure compensates for fitting height differences. Cut a minimum 1-3/4" hole in the pipe. If possible, measure the wall thickness and write it down for use in depth setting. Then install the threaded fitting (saddle, weldolet, etc.) on the pipe.

Meter Installation. Loosen the compression nut so that the adapter slides freely. Pull the meter fully upward and finger-tighten the compression nut. Using a thread sealant, install the adapter in the pipe fitting. Do not overtighten. Now loosen the compression nut, lower the meter to the appropriate depth setting (see diagram and instructions that follow). Caution: Do not allow the meter to fall into the pipe uncontrolled, as this may damage the meter. Be sure flow is in the direction of the arrow on the housing. Tighten compression nut fully.



TX115/215 INSTALLATION

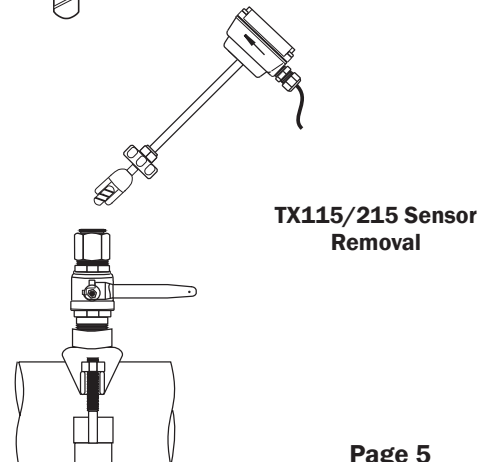
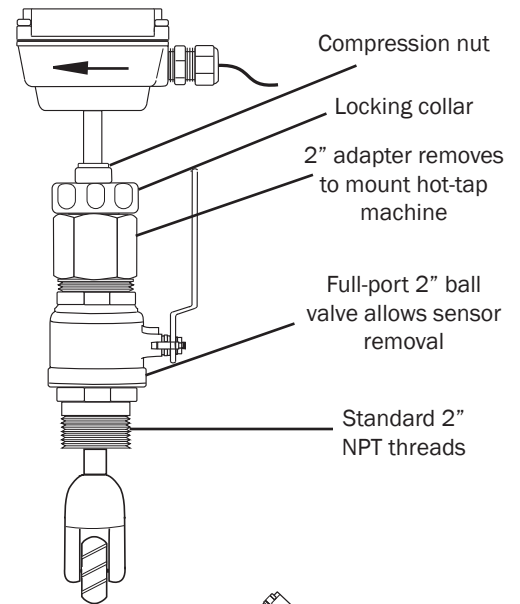
'Hot tap' TX meters are designed to be installed and serviced without depressurizing the pipe.

Fitting Installation. The TX115/215 sensors have a 2" NPT thread for compatibility with the 2" isolation valve. Any fitting that provides matching NPT female thread may be used. The installation procedure compensates for differences in fitting height.

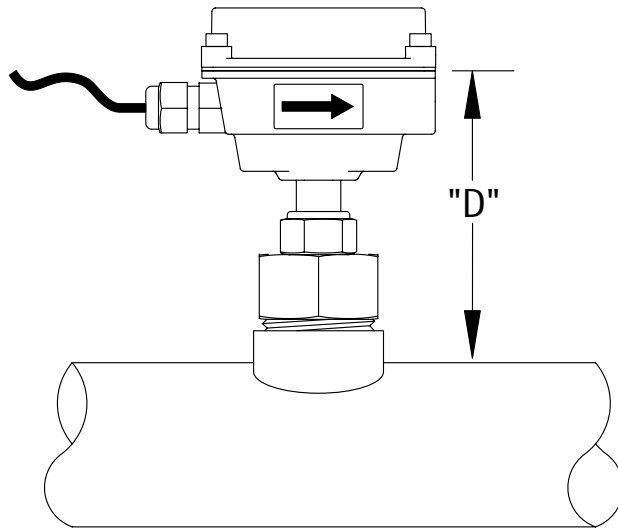
If initial installation is performed on an unpressurized pipe, cut a minimum 1-3/4" hole in the pipe. If possible, measure the wall thickness and write it down for use in depth setting. Then install the threaded fitting (saddle, weldolet, etc.) on the pipe.

If it is necessary to do the initial installation under pressure, any standard hot tap drilling machine with 2" NPT adapter, such as a Transmate or a Mueller, can be used. Ordinarily, it is not necessary to use an installation tool, since the small-diameter tube can be controlled by hand at all but the highest pressures.

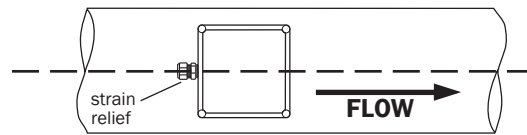
Meter Installation. Remove the sensor unit from the valve assembly. Using a thread sealant, install the valve assembly on the pipe fitting. If the initial installation is a pressure ("hot") tap, remove the 1-1/2" x 2" adapter bushing at the back of the valve. Thread the tapping machine on, open the valve, and tap using a minimum of 1-3/4" or maximum 1-7/8" cutter. After retracting the machine and closing the valve, reinstall the flow sensor. When the sensor is secure, open the valve and adjust depth setting (see diagram and instructions that follow). Be sure flow is in the direction of the arrow on the housing. Tighten locking collar and compression nut fully.



INSTALLATION



2. Measuring from the outside of the pipe to the joint in the housing, as shown in the diagram above, adjust the sensor to Dimension D and hand-tighten compression nut.
3. Align the conduit housing with the centerline of the pipe, as shown. Be sure the arrow on the housing points in the direction of flow.



4. Check Dimension D one more time.
5. Tighten the compression nut fully.

Proper Depth Setting. It is important for accuracy that the sensor be inserted to the correct depth into the pipe.

1. Please visit www.seametrics.com and select the K-factor Calculator located on the lower left of the homepage to find dimension 'D' (insertion depth setting) above.

RECORD YOUR SETTINGS

Once you have the meter set up and operational, it is important to record your meter settings and save them for future reference.

K-Factor _____

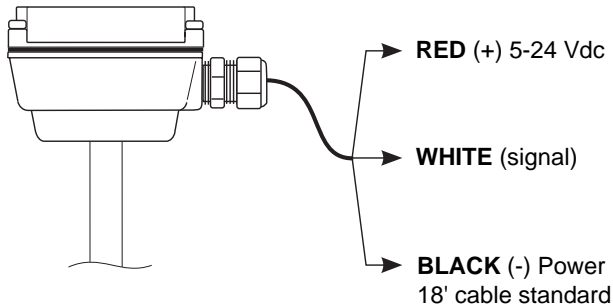
Insertion Depth (Dim. D) _____

TABLE 1: PIPE WALL THICKNESS

NOMINAL PIPE SIZE													
	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	24"	30"	36"
PVC/Steel Sch. 40	0.216	0.237	0.280	0.322	0.365	0.406	0.438	0.500	0.562	0.593	0.687		
PVC/Steel Sch. 80	0.300	0.337	0.432	0.500	0.593	0.687	0.750	0.843	0.937	1.031	1.218		
Stainless Steel (10S)	0.120	0.120	0.134	0.148	0.165	0.180	0.188	0.188	0.188	0.218	0.250	0.312	0.312
Stainless Steel (40S)	0.216	0.237	0.280	0.322	0.365	0.375	0.375	0.375	0.375	0.375	0.375	0.375	0.375
Copper Tubing (Type L)	0.090	0.110	0.140	0.200	0.250	0.280							
Copper Tubing (Type K)	0.109	0.134	0.192	0.271	0.338	0.405							
Brass Pipe	0.219	0.250	0.250	0.312	0.365	0.375							
Duct. Iron (Class 52)	0.280	0.290	0.310	0.330	0.350	0.370	0.390	0.400	0.410	0.420	0.440	0.470	0.530

SET-UP

Connection. Sensors are supplied with 18 ft. of cable. For sensors with no additional electronics, see diagram for color coding. For sensors with on-board electronics, see the manual accompanying the electronics module.



Calibration ("K-Factor"). In order to properly process pulses from the flow sensor, a number must be entered into the control to which the sensor is connected. This number, called the K-factor, is the number of pulses the sensor puts out per unit of fluid passing through the pipe. It is normally provided for Seametrics sensors in pulses per gallon, and can be ascertained by using the "K-Factor Calculator" on the Seametrics website. These numbers are based on extensive testing, which has shown close agreement between different TX sensors in the same installation. Most K-factor error can be attributed to installation variables, such as depth setting and fitting configuration.

It is possible to field calibrate a sensor by catching the fluid in a measured container and comparing with the number of pulses recorded. (To record individual pulses, set the K-factor on the control to 1.00.) This is especially desirable if the installation has less than the recommended length of straight pipe upstream of the sensor. For detailed instructions on field calibration, please refer to the technical bulletin on our website (www.seametrics.com/pdf/LT-13276-A.pdf).

OPERATION

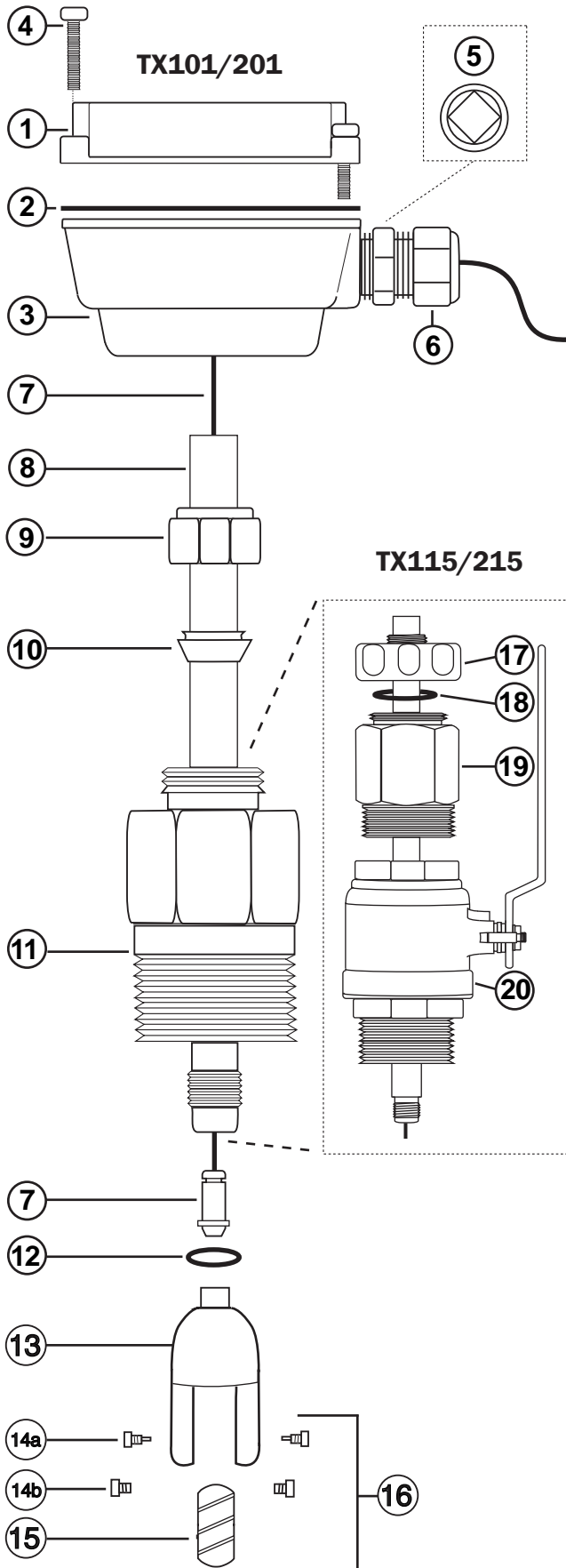
Flow Range. These sensors are designed to operate at flow velocities of 0.5 to 30 feet per second (see Table 2, below). If erratic readings are encountered at low flows, check the

chart to see if flow is below minimum for the pipe size. The standard shaft and bearings should have a long life at continuous high flow.

TABLE 2: Flow Rates converted from Feet/Sec to Gallons/Minute at various velocities: Schedule 40 pipe

Feet / Sec □ (0.5)	Nominal pipe size											
	3"	4"	5"	6"	8"	10"	12"	16"	24"	36"	38"	40"
(0.5)	11.5	19.8	31.2	45	78	123	176	313	704	1585	1770	1960
(1.0)	23	39.7	62.4	90	156	246	349	551	1250	2910	3530	3915
(2.0)	46.1	79.4	125	180	312	492	698	1100	2510	5830	7070	7825
(5.0)	115	198	312	450	780	1230	1740	2750	6270	14570	17670	19560
(10.0)	230	397	624	900	1560	2460	3490	5510	12530	29140	35350	39120
(20.0)	461	794	1250	1800	3120	4920	6980	11020	25060	58270	70700	78240
(30.0)	691	1190	1870	2700	4680	7370	10470	16520	37600	87410	106050	117500

PARTS LIST



TX 101/201 Parts

1	Upper housing assembly	30475
2	Housing Gasket	26211
3	Lower housing	Not Field Replaceable
4	Housing screw assembly	26229 (4 required)
5	Plug, steel	26073
6	Strain relief	07655
7	Sensor w/cable	26310 (Standard - FT420) 29953 (Micropower - FT415)
8	Tube	Not Field Replaceable
9	Compression nut	14199 (Brass) 15064 (SS)
10	Compression Ferrule	26065
11	Adapter fitting	30998 (Brass) 30999 (SS)
12	Rotor housing O-ring	16454
13	Rotor housing	Before Jan 1, 2011 25977 (Brass) 25978 (SS) After Jan 1, 2011 33023 (Brass) 33024 (SS)
14a	Jewel bearing assembly (for carbide shaft)	25901 (2 required)
14b	Jewel Bearing Assembly (for ceramic shaft)	16710 (2 required)
15	Turbine Rotor assembly	Before Jan 1, 2011 25946 (Polypro) 25947 (Kynar) After Jan 1, 2011 33015 (Kynar)
16	Rotor repair kit (consists of #15 & #16)	Before Jan 1, 2011 25930 (Poly/Carbide) 25945 (Kynar/Ceramic) After Jan 1, 2011 33087 (Kynar/Carb)

TX 115/215 Parts (hot tap)

All part numbers are the same except those below

17	Locking Collar	14190 (Brass) 15170 (SS)
18	Adapter fitting O-ring	26029
19	Adapter, hot tap	26130 (Brass) 26131 (SS)
20	Valve assembly (includes Adapter, #20)	14225 (Brass) 15225 (SS)

Troubleshooting



CAUTION! Never attempt to remove a flow sensor when there is pressure in the pipe. Loosen the compression nut slowly to release any trapped pressure. If fluid sprays out when removing the sensor, stop turning and depressurize the pipe. Failure to do so could result in the sensor being thrown from the pipe, resulting in damage or serious injury.

The flow sensor has only one moving part, the rotor. If this is turning properly and there is no signal, the Hall-effect sensor is not operating properly. To check the signal, apply 12 Vdc regulated* power to the red (+) and black (-) leads. Set a multimeter to voltage reading. Put the positive multimeter lead on the red wire and the negative lead on the white wire. Slowly turn the rotor. Voltage reading should swing between +12 Volts and 0 Volts as the rotor turns. If it does not, the Hall effect sensor is not working properly. Checking for continuity is not a useful test of these sensors.

***NOTE:** An unregulated power supply can exceed max voltage of micro powered sensor (gray cable) and damage sensor.

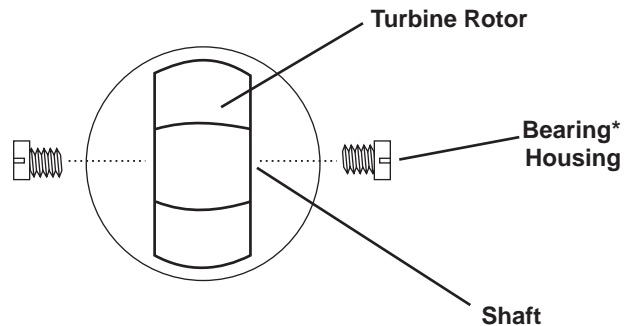
Repair

All Seametrics flow sensors are repairable, and can be returned to the factory or distributor for repair.

Please first obtain a Return Material Authorization (RMA) number.

Rotor Replacement.* Rotors are easily field-replaced. Shaft and rotor are a single unit, and are not replaced separately. If replacement is due only to normal shaft wear, bearing replacement is probably not necessary. If the rotor has been damaged by impact, the bearings should also be replaced. Rotor and bearings can be ordered as a kit (see parts listing). Follow these steps:

1. Unscrew the threaded bearing housings to expose the shaft ends. If bearings are being replaced, back them completely out.
2. Remove the rotor. Put the new rotor in its place.
3. Thread in one bearing housing part way, then the other. Take care to start the end of the shaft into the bearing hole before tightening further.
4. Screw in bearing housings until they bottom.
Note: Do not use excessive force.
5. Check for free spin. Blowing lightly on the rotor should result in it spinning rapidly and coasting to a smooth stop.



***NOTE:** Described here is the rotor/shaft/bearing configuration for the carbide shaft model. On ceramic shaft models the shafts are in the screws and the bearings are in the rotor. Follow the same basic procedure above.



Seametrics Incorporated • 19026 72nd Avenue South • Kent, Washington 98032 • USA
(P) 253.872.0284 • (F) 253.872.0285 • 1.800.975.8153 • www.seametrics.com



~~FT420~~

FEATURES

- Simple Setup
- **Battery (FT415)** or ~~Loop Powered (FT420)~~
- **Remote** or ~~Flow Sensor Mounted Indicator~~
- Rugged Metallic Housing
- Non-volatile Memory

APPLICATIONS

- Water Treatment
- Water Utility
- Industrial Chemical Handling



FT415

GENERAL INFORMATION

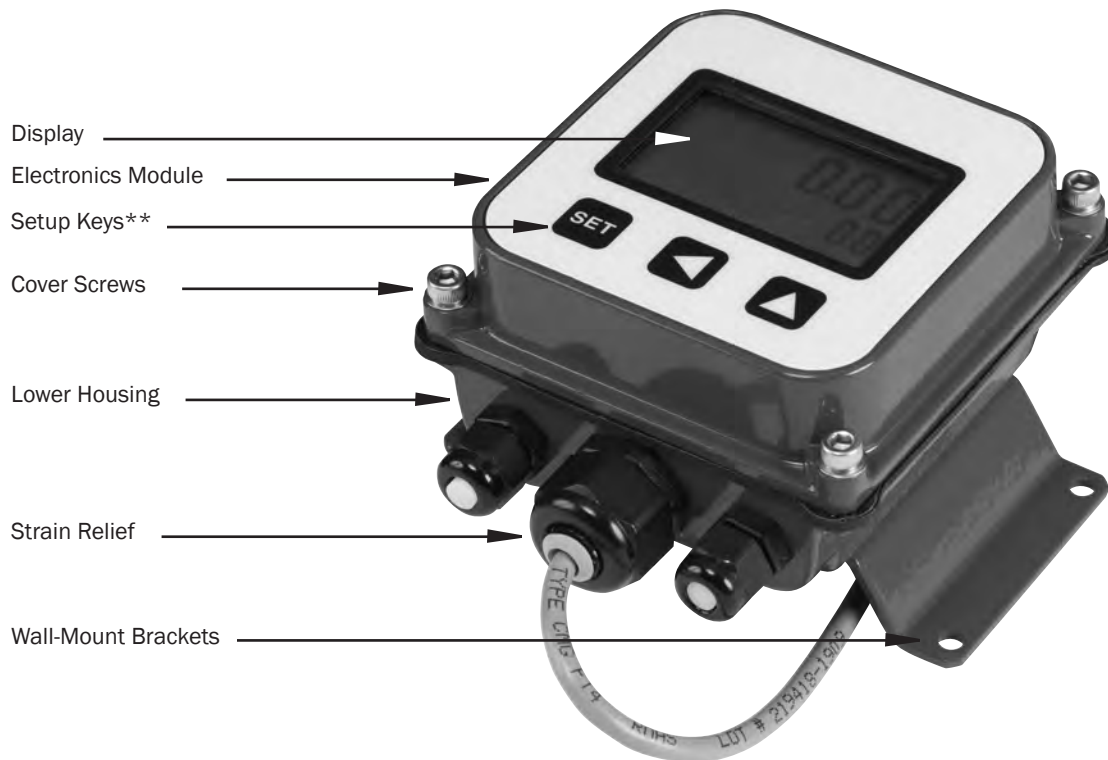
The FT400-Series flow computers are microcontroller-based indicator/transmitters that display flow rate and total and provide output signals. The FT415 is battery-powered and provides a scalable pulse output. ~~The FT420 is powered by external DC voltage and has both pulse and 4-20 mA analog outputs. When the FT420 is being used in the 4-20 mA mode, it is a "two-wire" or "loop-powered" device, meaning that the 4-20 mA output signal doubles as its power supply.~~

~~The addition of a dual-relay output board (FT420 only) allows for certain applications requiring contact output isolation (e.g., certain metering pumps and water treatment controls). Dual solid state relays provide exactly the same pulse output as the standard unit, and each can signal one external device. A non-resettable total is also available. The FT420 can be ordered in a plastic enclosure with a 115 Vac power supply for use with mechanical meters, or with a built-in 115 Vac/12-24 Vdc dual power supply for magmeters.~~

Both the FT415 and the ~~FT420~~ can be factory-mounted on the meter (-M) or remotely wall mounted with the brackets provided (-W). ~~The FT420 is also available as a panel mount (-P) with an open back for easy installation in the user's own electrical enclosure.~~ Most FT400's can be converted from wall-to-meter or meter-to-wall mount configurations after installation if needed.

Housings for the -W and ~~-M~~ models are rugged cast aluminum, potted and gasketed for maximum environmental protection. A membrane keypad allows settings to be changed without removing the cover. (Password protection, a standard feature, can be used to prevent settings from being changed.)

FEATURES



**Includes password protection for tamper prevention when needed

SPECIFICATIONS*



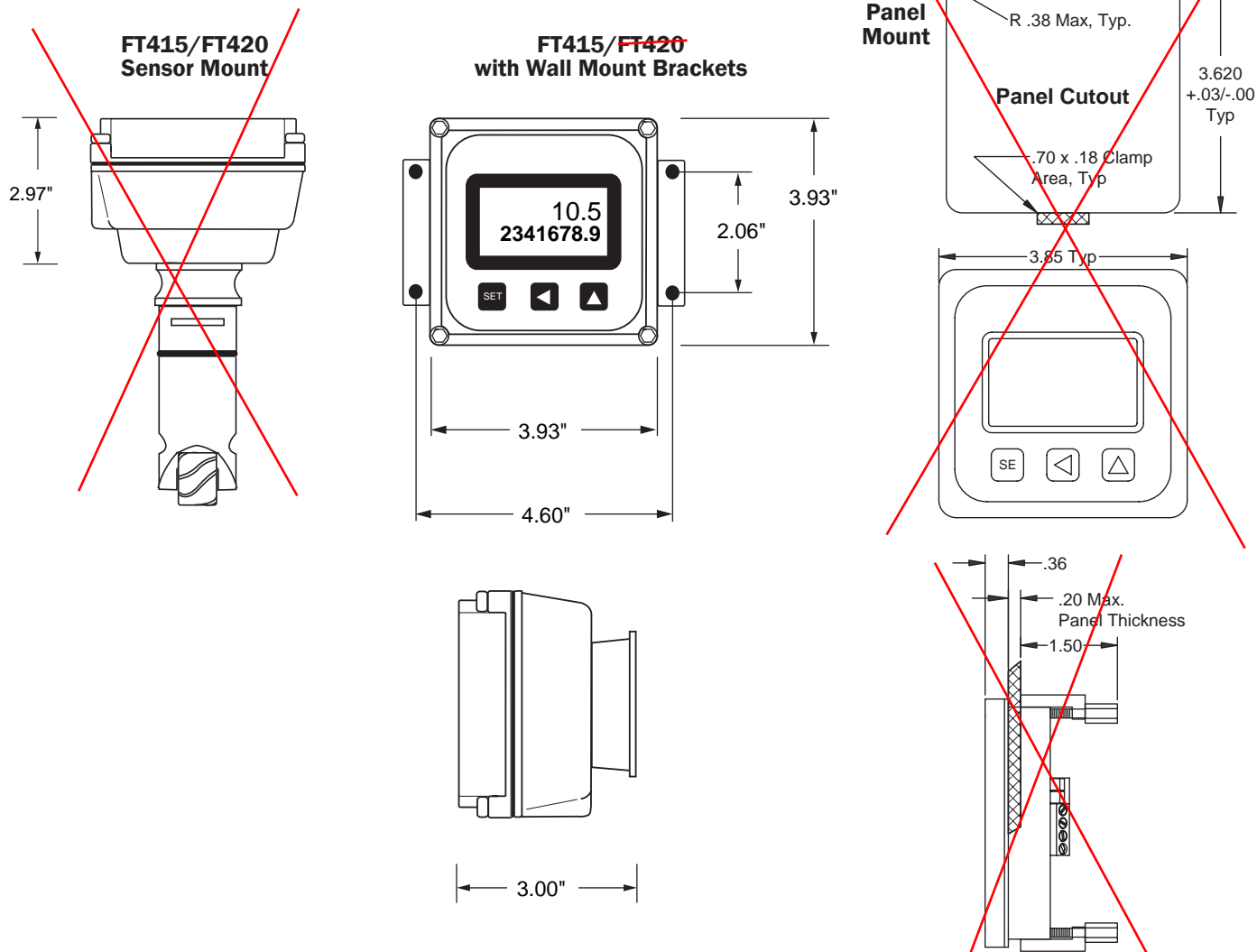
FT415

FT420

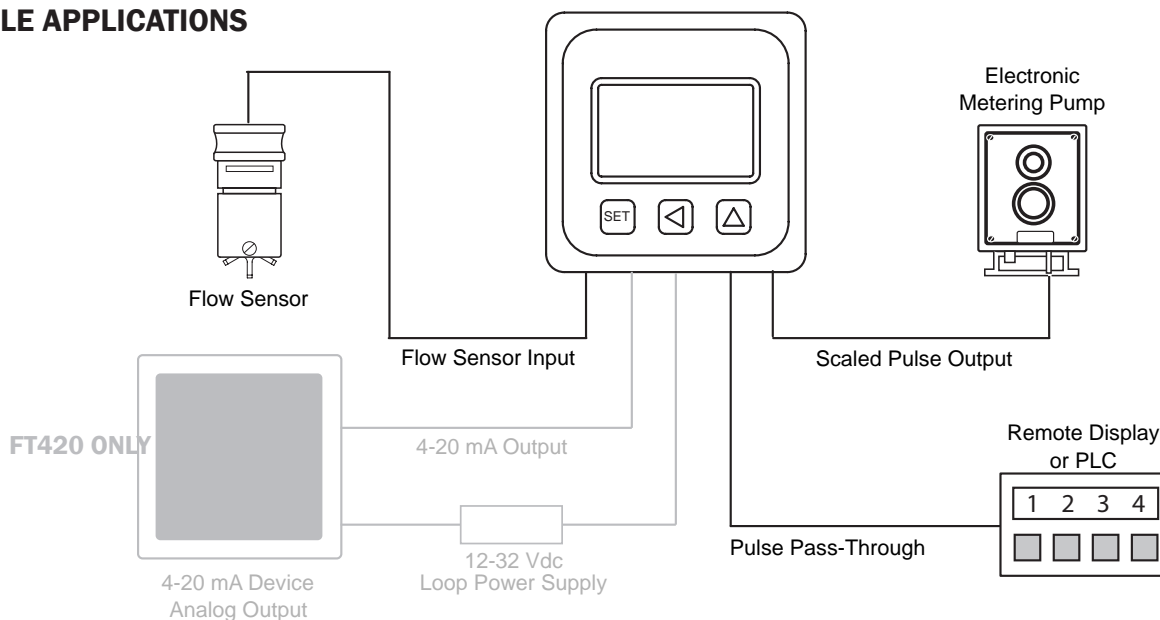
SPECIFICATIONS*		FT415	FT420
Power		Lithium "C", 3.6 Vdc, replaceable. Estimated life is 3-5 years depending on usage.	12-30 Vdc, 4mA (4-20 mA when loop-powered)
Display	Rate	6-digit autorange, 1/2" character height	6-digit autorange, 1/2" character height
	Total	8-digit, 5/16" character height	8-digit, 5/16" character height
Outputs	Current Sinking Pulse	Scaled Pulse output (0.1 sec duration 6.1 Hz max) (or High Alarm output or Low Alarm output) Sensor pass-through Pulse output (unscaled)	
	Analog	None	4-20 mA loop; 24-30 Vdc
Pulse Output Range		0.1 - 9999999.9 units/pulse	0.1 - 9999999.9 units/pulse
Input		Micropower GMR Sensor (square wave)	5V pulse or contact closure
Input Range		1.0 - 150 pulses/second	1.0 - 1,500 pulses/second
K-Factor Range		.001 - 99999.999	.001 - 99999.999
Flow Alarm Output Range		.01 - 999999.99	.01 - 999999.99
Operating Temperature		-30° to 65° C (-22° to 148° F)	-30° to 65° C (-22° to 148° F)
Environmental		NEMA 4X, IP66	NEMA 4X, IP66
Regulatory		None	CE Mark

*Specifications subject to change • Please consult our website for current data (www.seametrics.com).

DIMENSIONS



POSSIBLE APPLICATIONS





FT400-SERIES Rate/Total Indicator

HOW TO ORDER

MODEL	MOUNTING	OPTIONS
Battery-powered indicator = FT415	Premounted on meter = M	Built-in 115 Vac/12-24 Vdc dual power supply (FT420W only, use with magmeters) = -27
Loop-powered indicator/transmitter = FT420	Wall mount = W	Tamper-evident = -32
	Panel mount = P	Non-resettable total = -64
		Built-in 115 Vac power supply (FT420W only, use with mechanical meters) = -65
		Dual relay output (FT420 only) = -98

ACCESSORIES	
Data logger (wall mount) = DL76W	Mounting kit, wall-to-meter conversion = MK10
Power converter, plug-in, 115 Vac, 24 Vdc = PC3	Mounting kit, meter-to-wall conversion = MK20
Dual power supply, plug-in, 115 Vac, 12/24 Vdc = PC42	LMI pump power cable = 07483
Protective cover, hinged = 30785	LMI pulse out cable = 12010

CONTACT YOUR SUPPLIER

FT400-Series



RATE/TOTAL INDICATOR INSTRUCTIONS

- FT415
- FT420



FT400-SERIES RATE TOTAL/INDICATOR INSTRUCTIONS

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GENERAL INFORMATION

The FT400-Series flow computers are microcontroller-based indicator/transmitters that display flow rate and total and provide output signals. The FT415 is battery-powered and provides a scalable pulse output. The FT420 is powered by external DC voltage and has both pulse and 4-20 mA analog outputs. When the FT420 is being used in the 4-20 mA mode, it is a "two-wire" or "loop-powered" device, meaning that the 4-20 mA output signal doubles as its power supply.

The addition of a dual-relay output board (FT420 only) allows for certain applications requiring contact output isolation (e.g., certain metering pumps and water treatment controls). Dual solid state relays provide exactly the same pulse output as the standard unit, and each can signal one external device. A non-resettable total is also available. The FT420 can be ordered in a plastic enclosure with a 115 Vac power supply for use with mechanical meters, or with a built-in 115 Vac/12-24 Vdc dual power supply for magmeters.

FEATURES

Both the FT415 and the FT420 can be factory-mounted on the meter (-M) or remotely wall mounted with the brackets provided (-W). The FT420 is also available as a panel mount (-P) with an open back for easy installation in the user's own electrical enclosure. Most FT400's can be converted from wall-to-meter or meter-to-wall mount configurations after installation if needed.

Housings for the -W and -M models are rugged cast aluminum, potted and gasketed for maximum environmental protection. A membrane keypad allows settings to be changed without removing the cover. (Password protection, a standard feature, can be used to prevent settings from being changed.)

**Includes password protection for tamper prevention when needed



SPECIFICATIONS*

FT415

FT420

SPECIFICATIONS*		FT415	FT420
Power		Lithium "C", 3.6 Vdc, replaceable, 3-5 year life	12-30 Vdc, 4mA (4-20 mA when loop-powered)
Display	Rate	6-digit autorange, 1/2" character height	6-digit autorange, 1/2" character height
	Total	8-digit, 5/16" character height	8-digit, 5/16" character height
Outputs	Current Sinking Pulse	Scaled Pulse output (0.1 sec duration 6.1 Hz max) (or High Alarm output or Low Alarm output)	
		Sensor pass-through Pulse output (unscaled)	
	Analog	None	4-20 mA loop; 24-30 Vdc
Pulse Output Range		0.1 - 9999999.9 units/pulse	0.1 - 9999999.9 units/pulse
Input		Micropower GMR Sensor (square wave)	5V pulse or contact closure
Input Range		1.0 - 150 pulses/second	1.0 - 1,500 pulses/second
K-Factor Range		.001 - 99999.999	.001 - 99999.999
Flow Alarm Output Range		.01 - 999999.99	.01 - 999999.99
Operating Temperature		-30° to 65° C (-22° to 148° F)	-30° to 65° C (-22° to 148° F)
Environmental		NEMA 4X, IP66	NEMA 4X, IP66
Regulatory		None	CE Mark

*Specifications subject to change • Please consult our website for current data (www.seametrics.com).

INSTALLATION

Wall Mount. To mount an FT400-Series indicator to the wall, hold the unit in the desired position, mark the holes in the mounting feet, drill and mount with screws. With the FT420W-65 option, first remove the front cover to gain access to the mounting screw holes.

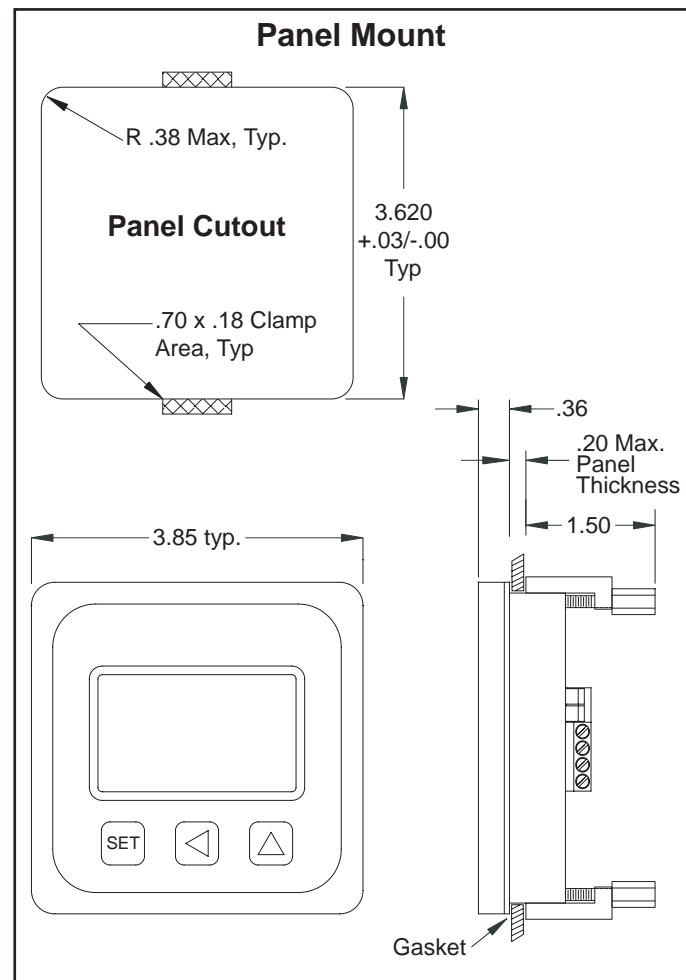
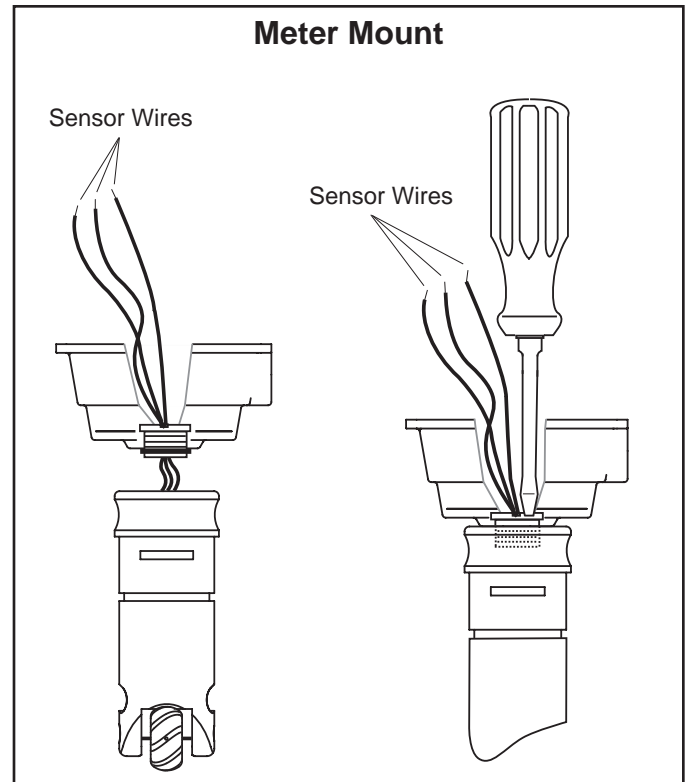
A meter-mounted FT400-Series can be converted to a wall mount using an MK20 mounting kit.

Meter Mount. If the FT400-Series indicator was ordered as an -M model, the housing is already directly mounted to the flow sensor and needs no further installation.

An FT400-Series module can be converted from a wall-to a meter-mount using the MK10 adapter kit that includes a lower housing and associated hardware as follows:

- 1) Remove the strain relief through which the flow sensor cable runs.
- 2) Cut the cable to about 6" in length. Carefully strip the cable jacket to expose the three colored wires (red, white, and black) inside.
- 3) Route the wires through the threaded connector pre-installed in the bottom of the housing.
- 4) Start the threaded connector into the female thread on the top of the flow sensor. Be sure to match the oblong shape on the bottom of the housing to the depression on the top of the flow sensor.
- 5) Using an ordinary screwdriver inserted in one side of the slot (see drawing), tighten the screw as much as possible.
- 6) Strip the wire ends, make the connections to the FT400-Series indicator as shown in Connections Diagrams, and then use the cover screws to attach the indicator to the top of the housing.

Panel Mount (FT420 Only). Using the "Panel Cutout" drawing as a guide, cut a square hole in the panel. Remove the clamps from the back of the FT420P and insert the indicator unit through the cutout, taking care that the panel sealing gasket is in place between the front of the panel and the flange of the indicator. Hold the indicator in place while starting the screw of one of the two clamps. Finger tighten the screw, then install the other clamp. When both are in place, firmly tighten the clamps with a small wrench or nut driver.



Connections. To connect the FT400-Series flow computer to a flow sensor or an external device such as a chemical metering pump, follow the Standard Connections diagrams on pages 4-6.

If the FT420's 4-20 mA current signal is not required, connect the power terminals to any 12-30 Vdc voltage source.

Dual Relay Output (Option -98). If you purchase the FT420 with option 98, the required component will come preinstalled, and no extra procedures are required.

If you are retrofitting an existing installation of an FT420 with the dual relay board, please follow the instructions below:

- 1) Peel the backing off of the double-stick tape and affix it to the bottom of the relay board (part #30221).
- 2) Carefully attach the board to the FT420 as shown in the FT420-98 Connection diagram on page 5. Be sure that the red wire faces the "Sensor Input" side of the FT420, and that the white wire faces the "Pulse Output" side.
- 3) Connect the white wire to the "Pulse Scaled" positive terminal, and the red wire to the "Power 4-20 mA" positive terminal.
- 4) Connect devices to the relays as desired.




Caution: If output is being used to control an external device, such as a metering pump, do not connect the device until programming is completed. If malfunction or incorrect programming of the output could cause personal injury or property damage, separate safeguards must be installed to prevent such injury or damage.

-98 Relay Board Specifications

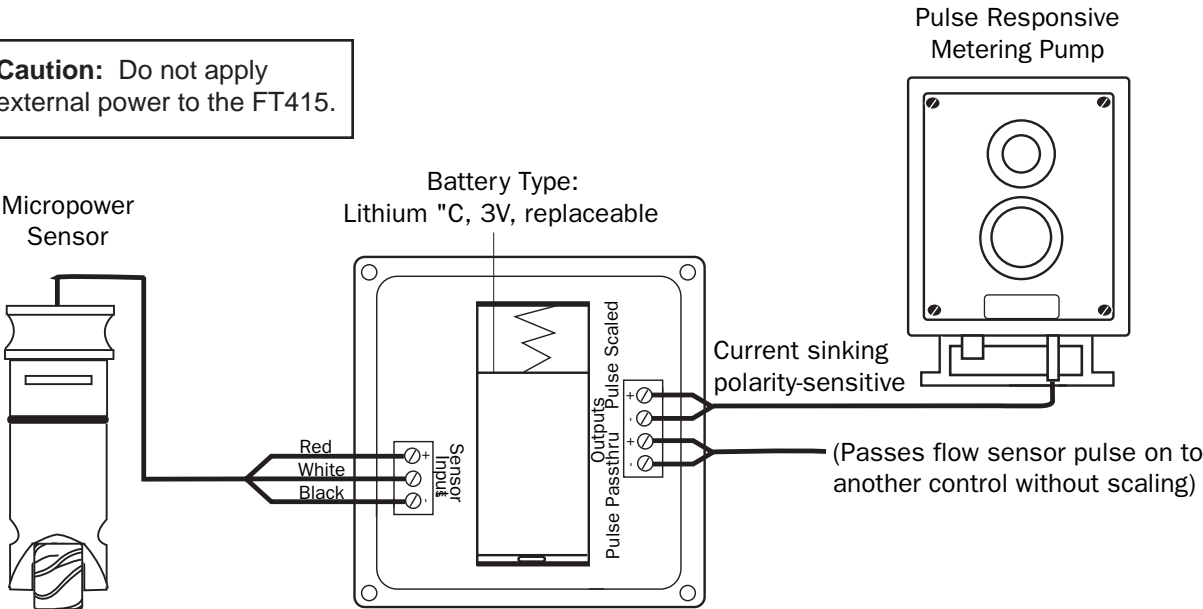
Output Voltage	0-130 VAC/DC	
Output Current (each output)		
Temperature	50° C	85° C
Current Limit	100 mA	50 mA
Max Pulses/Second		5
Contact Time Per Output		100 ms

CONNECTION DIAGRAMS

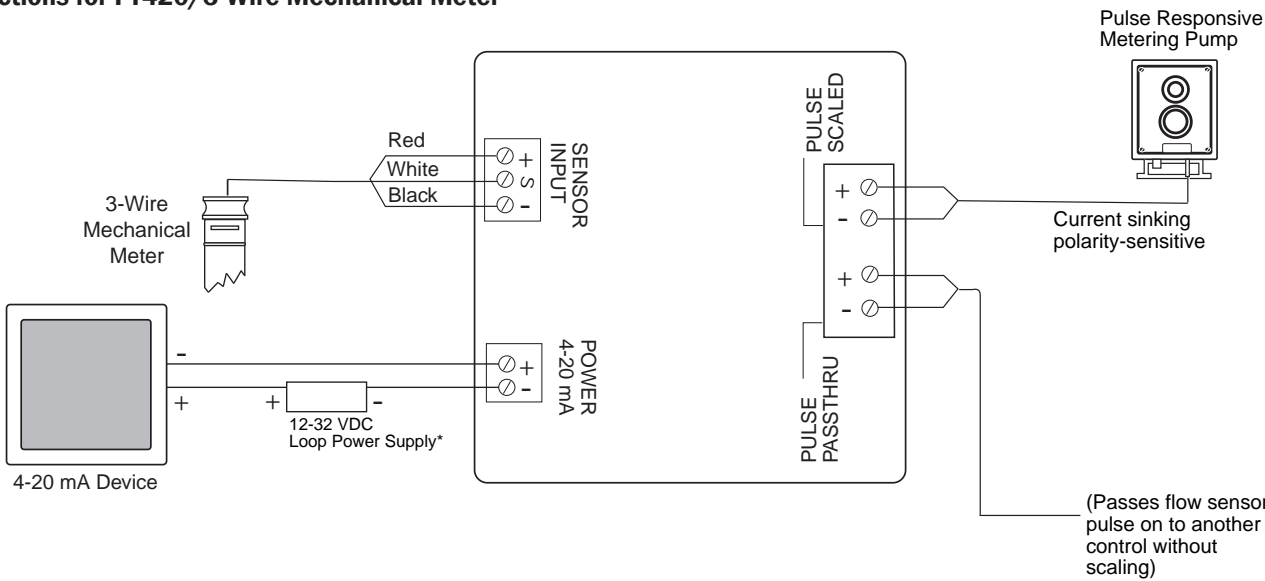
FT415 Standard Connections



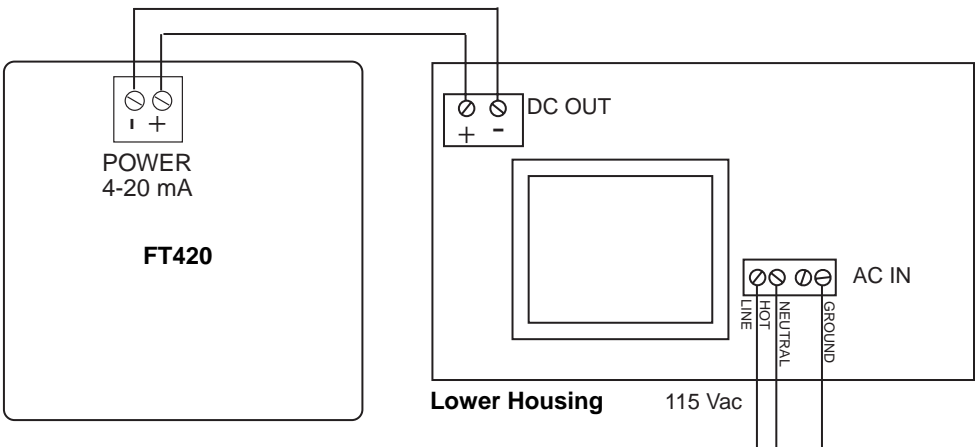
Caution: Do not apply external power to the FT415.



Connections for FT420/3-Wire Mechanical Meter

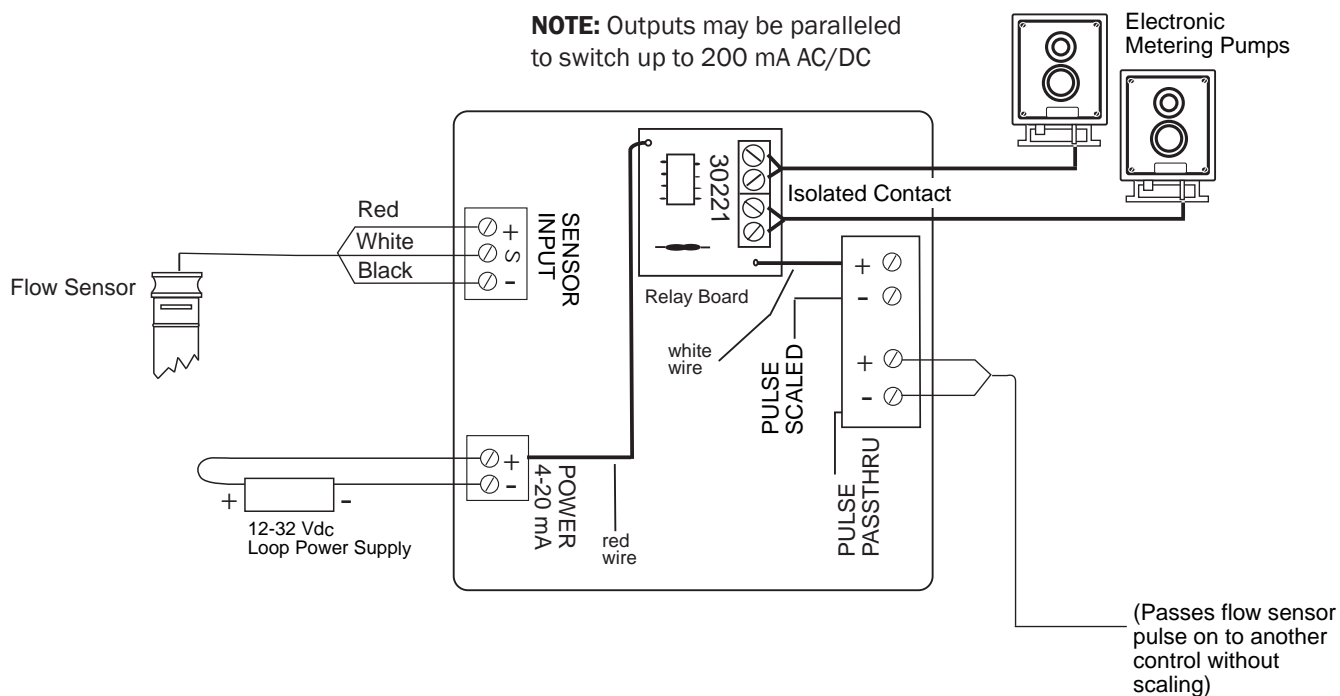


Connections for FT420-65 (115 Vac Option)

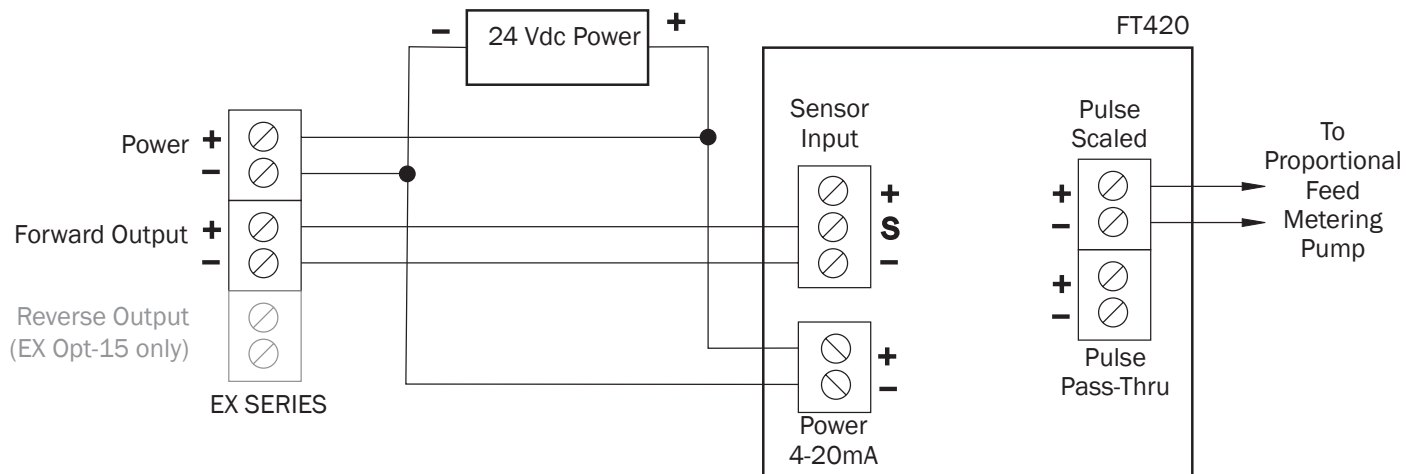


CONNECTION DIAGRAMS

Connections for FT420-98 (Dual Relay Output Option)



Connections for FT420/EX Magmeter



CONNECTION DIAGRAMS

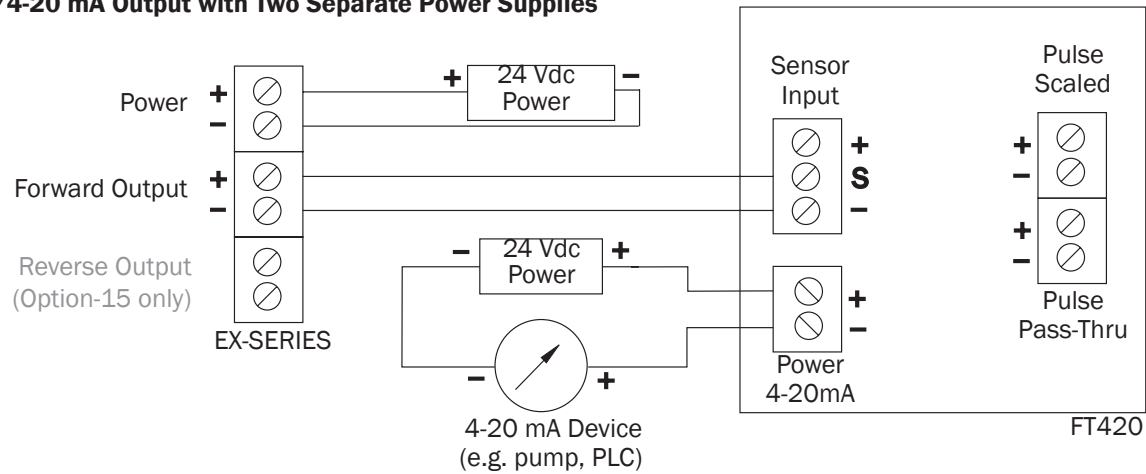
FT420 Display with 4-20 mA Output

When running the FT420 with a magmeter (which requires power), the FT420 must be connected to two power supplies, one for the magmeter and one for the 4-20 mA loop. You may either use a dual power supply (available from Seametrics as the PC42), or two single power supplies (one of which may be the 4-20 mA loop itself). See diagrams below.



Caution: Important! Do not connect power to the power supply until all connections have been made and confirmed correct, and the cover has been put back into place.

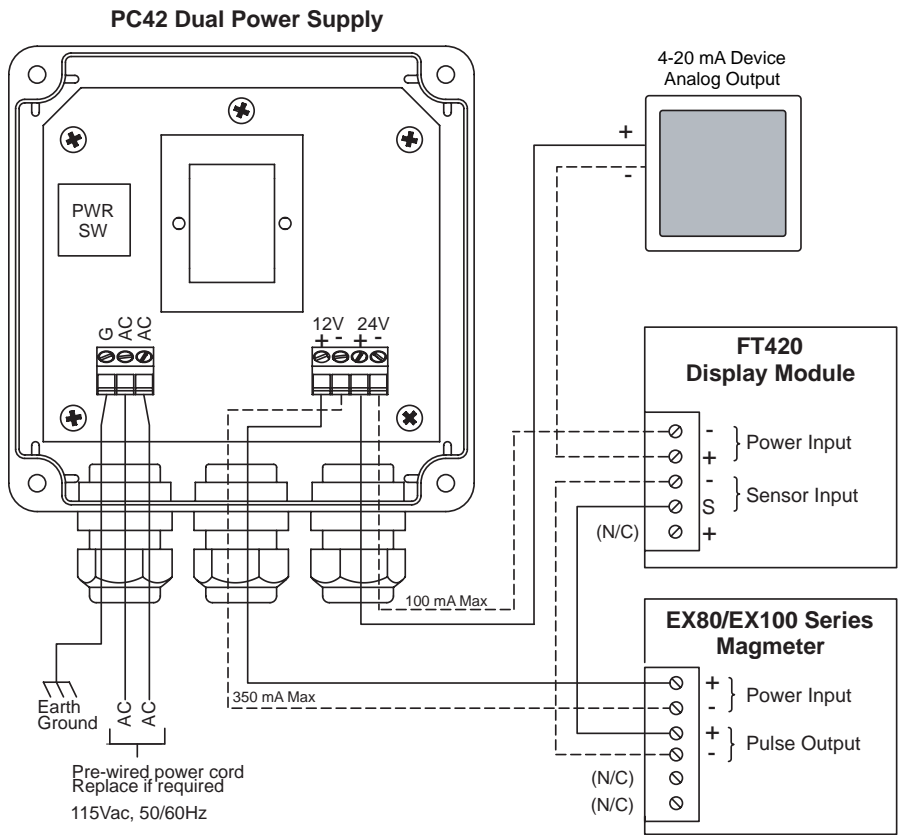
FT420/4-20 mA Output with Two Separate Power Supplies



FT420/4-20 mA Output with PC42 Dual Power Supplies



Caution: It is essential for safety and proper operation to use a ground connection for the 115 Vac power. Do not use this power supply without proper grounding.



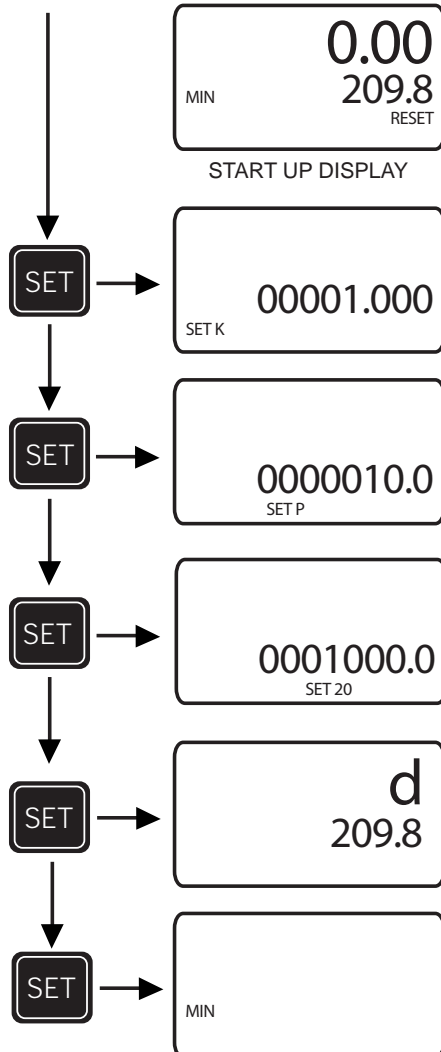
QUICK SETTINGS OVERVIEW

See following page for step-by-step instructions on changing these settings

Pass through all settings and return to original display to save settings.

PRESS

DISPLAY



Large digits display instantaneous flow rate (GPM).

Small digits display total flow (since last reset).

K is the number of pulses the flow sensor provides for every gallon of flow. Find it on the fitting (80-Series) or chart (100/200-Series) or on the Seametrics website.

P is the number of gallons per pulse desired on the scalable pulse output. (Example: P=1 is one pulse per gallon.) Skip without changing if you are not using the pulse output.

20 is the 20 mA maximum analog output. Set the flow rate you want to match maximum output. Example: 250 gpm maximum expected flow, "set 20" to 250. The analog output will scale to 4 mA at zero flow, 20 mA at 250 gpm*. **This setting appears on the FT420 ONLY.**

d is the decimal point. It toggles back and forth with the . Set as many decimal places as needed. For higher flows, no decimal allows maximum number of whole digits.

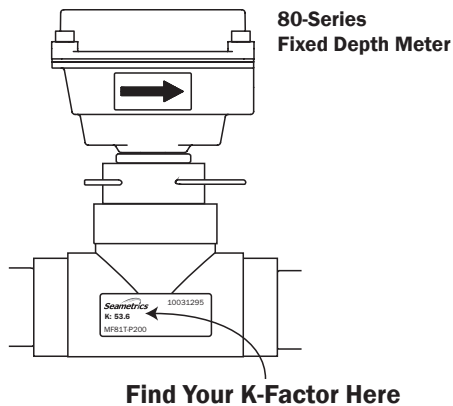
MIN is the time base, for example, gallons per minute. Use the to select sec/min/hour/day.

***NOTE:** Use the up arrow key to reach your desired digit. Then press the left arrow key to move to the next digit. Repeat the process until the entire number is entered.

K-FACTOR

At a minimum, every FT400-Series flow computer must be programmed with the "K-factor". (This is the number of pulses that the meter produces per gallon of flow.) If you wish the FT400 to read in units other than gallons, see below.

The K-factor on any Seametrics flow sensor fitting or in-line meter can be found on the model-serial label. The line reading K = xxxx gives the desired number. For depth-adjustable sensors (101,201,115,215 models), look in the instruction manual under your pipe size. For EX meters, use the calculator on our website.



READING IN OTHER UNITS

Changing Volume Units. The default K-factor units are pulses per gallon. To read your total in metric or other units instead, the standard K-factor must be converted to the desired volume units. For example, to read in pulses per liter, the K-factor must be multiplied by the applicable number shown below.

NOTE: Both rate & total will read in whatever units you choose.

To Convert K to:	Multiply by:
Liters	.26418
Cubic Meters	264.18
Fluid Ounces	.0078
Cubic Feet	7.48

Changing Time Units: To read your rate in liters per second (for example), convert the K-factor volume units as shown above and change the time units to Seconds, using the Set Time Unit instructions at right.

Set K. Begin by pressing the SET key once. The prompt SET K should appear on the display. The digit to the far right will be blinking. Use the up arrow key to reach your desired value. Then press the left arrow key to move to the next digit. Repeat the process until the entire number is entered. (Note that the decimal is fixed at three places. If you only have two decimal places for your K-factor, enter a zero for the third digit.) Press SET to advance. (**Note:** If unable to set K-factor, the unit is "locked" to prevent tampering. Please contact your Distributor for assistance.)

Set P/Flow Alarm. At this screen you may select between pulse output (P) or flow alarm (A) functions. If the pulse output and flow alarm features are not being used, this step can be skipped. The P (pulse output) setting does not affect anything if it is not being used.

Set P is the default that appears on a new FT400-Series. On an FT400 that has been previously set up with flow alarm function, an A will appear on this screen. To move between P and A screens, firmly press all three keys for 5-10 seconds, then use the up arrow to scroll through the three options: P, AL HI (high flow alarm) and AL LO (low flow alarm).

Set P. From this screen, follow the same process as for Set K to enter the desired pulse rate. This is the number of gallons (or whatever units are programmed) between pulses. (**Note:** Using the pulse output function disables the high and low flow alarm functions.) (6.1 Hz max output)

Set Flow Alarm. From the A screen, use the up arrow key to choose either AL HI or AL LO and then press the SET key to set the alarm rate. Use the up arrow and left arrow as above to reach the desired digits. (**Note:** Using the flow alarm function disables the pulse output function.)

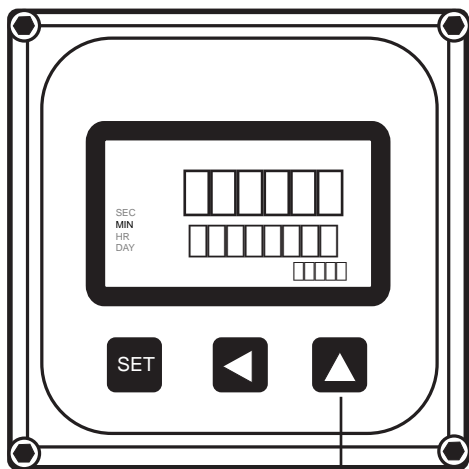
Set 20 mA (FT420 Only). Press the SET key to advance to SET 20, to set the flow rate, in volume units per time unit, at which 20 mA is desired. Use the up arrow key to reach your desired value. Then press the left arrow key to move to the next digit. Repeat the process until the entire number is entered. The processor will automatically scale the 4-20 mA loop accordingly, with 4 mA at zero flow.

Set Decimal Point. Press the SET key again for the D prompt. Pressing the up arrow key switches among no decimal place, one decimal place and two decimal places.

Set Time Unit. When the SET key is pressed again, a blinking time unit appears. Press the up arrow key to select SEC (seconds), MIN (minutes), HR (hours) or DAY (days) (for example, gal/min, or gal/hr).

To save settings and return to normal operation after entering settings, press SET again. When the unit is connected to an operating flow sensor, the rate (larger digits) and total (smaller digits) indicator numbers should appear in the display.

Resettable/Non-Resettable Totalizer. Unless the unit has been ordered with the non-reset option, a RESET prompt is visible in the lower right corner above the up arrow key, when the display is in use. Press the up arrow key at any time to reset the totalizer to zero. (**Note:** If you need to reset a unit that has been ordered with a non-resettable totalizer, contact your distributor.)



This key resets total to zero when in normal run mode.



CAUTION: Do not touch up Arrow button unless you intend to RESET Total to Zero. TOTAL IS NOT RECOVERABLE.



(either standard electronic or relay-type), it should pulse for 0.1 second every time the set number of gallons has been totalized. If a pulse-responsive metering pump is properly connected to this output, it should stroke periodically. If this does not occur, see Troubleshooting, back page.

FT415 Battery Change. The expected average life of the battery ranges between 3-5 years depending on the frequency of the input. The battery is easily pulled and replaced. When the battery is removed, all of the settings will be retained.



CAUTION: During a battery change, the totalizer will reset to a previous total, which represents the last auto-backup (auto backups occur at approximately 4 minute intervals). If it is necessary to save the exact current total at the time of the battery change, save before removing the battery as follows:

- 1) Simultaneously press the SET and up arrow keys
- 2) Press SET again
- 3) Again simultaneously press the SET and up arrow keys

Operation of 4-20 mA Output (FT420 Only). If the 4-20 mA output is in use and is correctly connected, the signal should vary between 4 mA and 20 mA in proportion to the flow, with the top flow rate set by the user (see Settings, page 8). At no time should the signal drop below 4 mA. A reading between 0 and 4 mA indicates a fault of some type, typically in the loop power supply or the connections (see Troubleshooting, back page). In the rare instance that the 4-20 signal fluctuates excessively ("paints") it may need to be damped by additional averaging. Contact Seametrics for information on how to increase filtering.

Operation of the Pulse Output. If the pulse output is being used

TROUBLESHOOTING

Problem	Probable Cause	Try...
Display blank	No power to the unit Short in sensor circuit Battery dead or loose (FT415 only)	Check for minimum 12 Vdc at power terminals Disconnect sensor, see if display returns (zero flow rate) Wiggle battery, replace if over three years old
Display missing segments	Damaged display module	Contact distributor for return/replacement
Display reading meaningless characters	Unit's microcontroller crashed Battery nearly dead	Disconnect and reconnect power, if problem repeats, contact distributor for return/replacement Replace battery if over three years old
Display reads normally, flow rate incorrect	Wrong K-factor or time base entered	Enter correct K-factor from meter, fitting, or manual
Display reads normally, incorrect pulse output	Wrong pulse output setting Polarity reversed on pulse output terminals	Use "Set P" to correct pulse output setting Reverse leads
Display reads normally, but no (or incorrect) 4-20 mA output (FT420 only)	Wrong 20 mA setting Inadequate loop power supply voltage Polarity incorrect in 4-20 mA loop circuit	Use "Set 20" to correct target top flow rate Check voltage (For 4-20 mA applications, 24 Vdc recommended) Compare to Connections diagram
Display reads zero when there is flow	Flow sensor failed Break in flow sensor circuit Flow sensor not battery-compatible	Consult flow sensor manual for how to test Check for continuity with multimeter Check flow sensor model number for "micropower option"
Display reads flow rate when there is none	Long flow sensor wire, running parallel to power wires Flow sensor malfunction Flow "jitter" (oscillating slosh) reads as flow	Reroute wire or change to shielded wire See flow sensor manual to check Consult factory for "anti-jitter" setting



Seametrics Incorporated • 19026 72nd Avenue South • Kent, Washington 98032 • USA
(P) 253.872.0284 • (F) 253.872.0285 • 1.800.975.8153 • www.seametrics.com

LT-65200063-D
9/20/10



94-01
(Full Internal Port)
MODEL → **694-01**
(Reduced Internal Port)

Combination Pressure Reducing and Surge Control Valve



Schematic Diagram

Item	Description
1	100-01 Hytrol (Main Valve)
2	X58C Restriction Assembly
3	CRD Pressure Reducing Control
4	CRL Pressure Relief Control

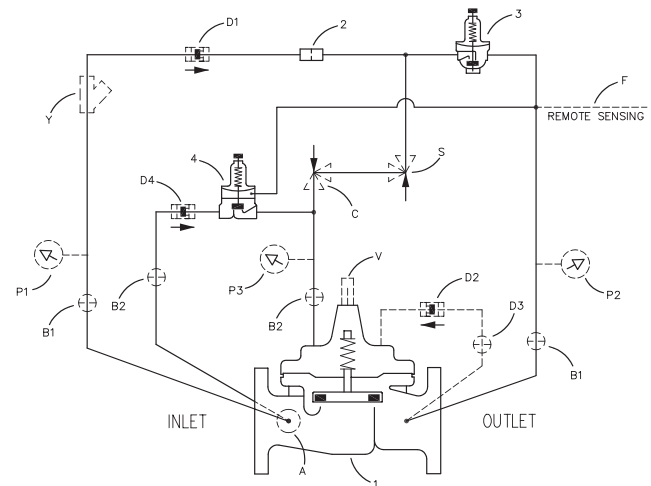
Optional Features

Item	Description
A	X46A Flow Clean Strainer
B	CK2 (Isolation Valve)
C	CV Flow Control (Closing)*
D	Check Valves with Isolation Valve
F	Remote Pilot Sensing
P	X141 Pressure Gauge
S	CV Speed Control (Opening)
V	X101 Valve Position Indicator
Y	X43 "Y" Strainer

*The closing speed control (optional) on this valve should always be open at least three (3) turns off its seat.

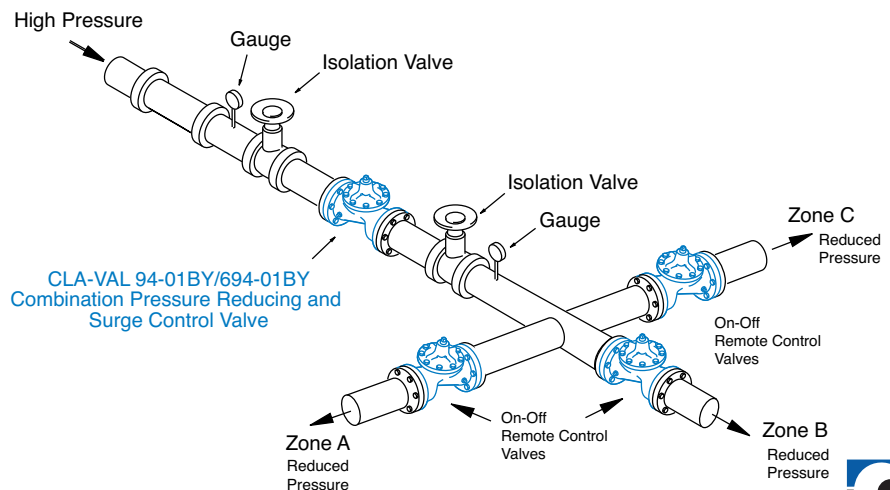
- Sensitive and Accurate Pressure Control
- Easy Adjustment and Maintenance
- Tamper Resistant
- Optional Check Feature
- Fully Supported Frictionless Diaphragm

The Cla-Val Model 94-01/694-01 Combination Pressure Reducing and Surge Control Valve automatically reduces a higher inlet pressure to a steady lower downstream pressure, regardless of changing flow rate and/or varying inlet pressure. This valve is an accurate, pilot-operated control valve capable of holding downstream pressure to a pre-determined limit. When downstream pressure rapidly exceeds the pressure setting of the pressure reducing control pilot, the surge pilot (CRL) will open quickly to prevent a rapid pressure rise downstream. If a check feature is added, and a pressure reversal occurs, the downstream pressure is admitted in the main valve cover chamber closing the valve to prevent return flow.



Typical Application

Should the downstream pressure suddenly increase above the setting of the pressure reducing control due to on-off operation of two or more downstream systems, the Surge Control tracks rapidly enough to prevent high pressure surges from entering any of the downstream systems, when any one of the downstream systems is rapidly closed off. The typical combination pressure reducing and surge control valve station uses Model 94-01BY/694-01BY to control surges in downstream piping as remote control valves change from one downstream zone to another. Surge Control is set approximately 10 psi above Pressure Reducing Control to prevent high pressure surge entering other downstream zones.



Model 694-01 (Uses Basic Valve Model 100-20)

Dimensions (In inches)

Pressure Ratings (Recommended Maximum Pressure - psi)

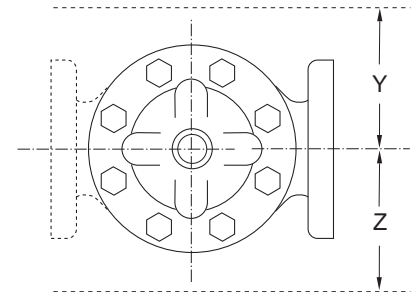
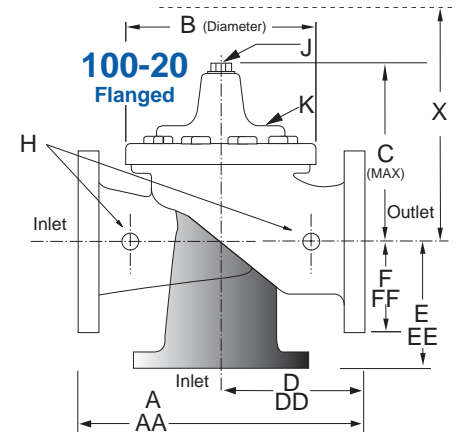
Valve Body & Cover		Pressure Class		
		Flanged		
Grade	Material	ANSI Standards*	150 Class	300 Class
ASTM A536	Ductile Iron	B16.42	250	400
ASTM A216-WCB	Cast Steel	B16.5	285	400
ASTM B62	Bronze	B16.24	225	400

Note: * ANSI standards are for flange dimensions only.
Flanged valves are available faced but not drilled.
Valves for higher pressure are available; consult factory for details

Materials

Component	Standard Material Combinations		
Body & Cover	Ductile Iron	Cast Steel	Bronze
Available Sizes	3" - 48"	3" - 16"	3" - 16"
Disc Retainer & Diaphragm Washer	Cast Iron	Cast Steel	Bronze
Trim: Disc Guide, Seat & Cover Bearing	Bronze is Standard Stainless Steel is Optional		
Disc	Buna-N® Rubber		
Diaphragm	Nylon Reinforced Buna-N® Rubber		
Stem, Nut & Spring	Stainless Steel		

For material options not listed, consult factory.
Cla-Val manufactures valves in more than 50 different alloys.



Model 694-01 Dimensions (In Inches)

Valve Size (Inches)	3	4	6	8	10	12	14	16	18	20	24	30	36	42	48
A 150 ANSI	10.25	13.88	17.75	21.38	26.00	30.00	34.25	35.00	42.12	48.00	48.00	63.25	65.00	76.00	94.50
AA 300 ANSI	11.00	14.50	18.62	22.38	27.38	31.50	35.75	36.62	43.63	49.62	49.75	63.75	67.00	76.00	94.50
B Dia.	6.62	9.12	11.50	15.75	20.00	23.62	27.47	28.00	35.44	35.44	35.44	53.19	56.00	66.00	66.00
C Max.	7.00	8.62	11.62	15.00	17.88	21.00	20.88	25.75	25.00	31.00	31.00	43.94	54.60	61.50	61.50
D 150 ANSI	—	6.94	8.88	10.69	CF*	CF*	CF*	CF*	CF*	CF*	CF*	—	—	—	—
DD 300 ANSI	—	7.25	9.38	11.19	CF*	CF*	CF*	CF*	CF*	CF*	CF*	—	—	—	—
E 150 ANSI	—	5.50	6.75	7.25	CF*	CF*	CF*	CF*	CF*	CF*	CF*	—	—	—	—
EE 300 ANSI	—	5.81	7.25	7.75	CF*	CF*	CF*	CF*	CF*	CF*	CF*	—	—	—	—
F 150 ANSI	3.75	4.50	5.50	6.75	8.00	9.50	11.00	11.75	15.88	14.56	17.00	19.88	25.50	28.00	31.50
FF 300 ANSI	4.12	5.00	6.25	7.50	8.75	10.25	11.50	12.75	15.88	16.06	19.00	22.00	27.50	28.00	31.50
H NPT Body Tapping	.375	.50	.75	.75	1	1	1	1	1	1	1	1	2	2	2
J NPT Cover Center Plug	.50	.50	.75	.75	1	1	1.25	1.25	2	2	2	2	2	2	2
K NPT Cover Tapping	.375	.50	.75	.75	1	1	1	1	1	1	1	1	2	2	2
Stem Travel	0.6	0.8	1.1	1.7	2.3	2.8	3.4	3.4	3.4	4.5	4.5	6.5	7.5	8.5	8.5
Approx. Ship Wt. Lbs.	45	85	195	330	625	900	1250	1380	1500	2551	2733	6500	8545	12450	13100
X Pilot System	13	15	27	30	33	36	36	41	40	46	55	68	79	85	86
Y Pilot System	10	11	18	20	22	24	26	26	30	30	30	39	40	45	47
Z Pilot System	10	11	18	20	22	24	26	26	30	30	30	39	42	47	49

*Consult Factory

Note: The top two flange holes on valve sizes 36 thru 48 are threaded to 1 1/2"-6 UNC.

94-01 Valve Selection	100-01 Pattern: Globe (G), Angle (A), End Connections: Threaded (T), Grooved (GR), Flanged (F) Indicate Available Sizes																		
	Inches	1	1½	1½	2	2½	3	4	6	8	10	12	14	16	18	20	24	30	36
	mm	25	32	40	50	65	80	100	150	200	250	300	350	400	450	500	600	750	900
Basic Valve 100-01	Pattern	G, A	G, A	G, A	G, A	G, A	G, A	G, A	G, A	G, A	G, A	G, A	G, A	G, A	G	G	G, A	G	G
	End Detail	T	T	T, F, Gr*	T, F, Gr	T, F, Gr*	T, F, Gr	F, Gr	F, Gr*	F, Gr*	F	F	F	F	F	F	F	F	F
Suggested Flow (gpm)	Maximum	55	93	125	210	300	460	800	1800	3100	4900	7000	8400	11000	14000	17000	25000	42000	50000
	Maximum Intermittent	68	120	160	260	370	580	990	2250	3900	6150	8720	10540	13700	17500	21700	31300	48000	62500
	Minimum	1	1	1	1	2	2	4	10	15	35	50	70	95	120	150	275	450	650
Suggested Flow (Liters/Sec)	Maximum	3.5	6	8	13	19	29	50	113	195	309	442	530	694	883	1073	1577	2650	3150
	Maximum Intermittent	4.3	7.6	10	16	23	37	62	142	246	387	549	664	863	1104	1369	1972	3028	3940
	Minimum	.03	.03	.03	.06	.09	0.13	0.25	0.63	0.95	2.2	3.2	4.4	6.0	7.6	9.5	17.4	28.4	41.0
100-01 Series is the full internal port Hytrol. For Lower Flows Consult Factory																			*Globe Grooved Only

694-01 Valve Selection	100-20 Pattern: Globe (G), Angle (A), End Connections: Flanged (F) Indicate Available Sizes															
	Inches	3	4	6	8	10	12	14	16	18	20	24	30	36	42	48
	mm	80	100	150	200	250	300	350	400	450	500	600	750	900	1000	1200
Basic Valve 100-20	Pattern	G	G, A	G, A	G, A	G	G	G	G	G	G	G	G	G	G	G
	End Detail	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
Suggested Flow (gpm)	Maximum	260	580	1025	2300	4100	6400	9230	9230	16500	16500	16500	28000	33500	33500	33500
	Minimum	1	2	4	10	15	35	50	50	95	95	95	275	450	450	450
Suggested Flow (Liters/Sec)	Maximum	16	37	65	145	258	403	581	581	1040	1040	1040	1764	2115	2115	2115
	Minimum	.06	.13	.25	.63	.95	2.2	3.2	3.2	6.0	6.0	6.0	17.4	28.4	41.0	41.0
100-20 Series is the reduced internal port size version of the 100-01 Series. For Lower Flows Consult Factory																

Many factors should be considered in sizing pressure reducing valves including inlet pressure, outlet pressure and flow rates. For sizing questions or cavitation analysis, consult Cla-Val with system details.

Pilot System Specifications

Adjustment Ranges

CRD

2 to 30 psi
15 to 75 psi
20 to 105 psi
30 to 300 psi*

CRL

0 to 75 psi
20 to 105 psi*
20 to 200 psi
100 to 300 psi

*Supplied unless otherwise specified

Other ranges available, please consult factory.

Temperature Range

Water: to 180°F

Temperature Range

Water: to 180°F

Materials

Standard Pilot System Materials

Pilot Control: Bronze ASTM B62

Trim: Stainless Steel Type 303

Rubber: Buna-N® Synthetic Rubber

Optional Pilot System Materials

Pilot Systems are available with optional Aluminum, Stainless Steel, Monel or Cast Steel materials.

Note: Available with remote sensing control.

When Ordering, Please Specify

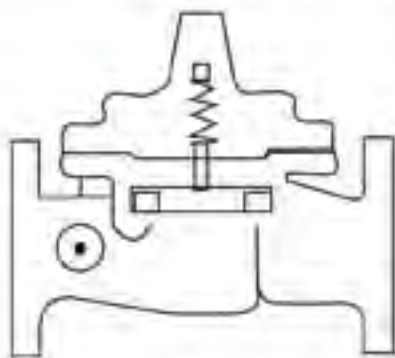
1. Catalog No. 94-01 or No. 694-01
2. Valve Size
3. Pattern - Globe or Angle
4. Pressure Class
5. Threaded or Flanged
6. Trim Material
7. Adjustment Range
8. Desired Options
9. When Vertically Installed

CLA-VAL

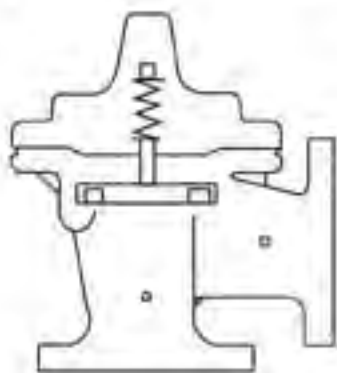
AUTOMATIC CONTROL VALVES

94-01/694-01

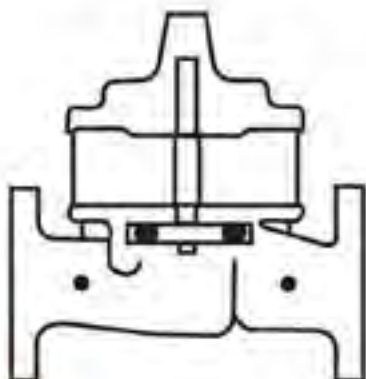
*Please this manual with personnel responsible
for maintenance of this valve.*



INSTALLATION



OPERATION



MAINTENANCE



CLA-VAL • P.O. BOX 1325 • NEWPORT, CA 92659-0325 • (949) 722-4800 • FAX: (949) 548-5441
CLA-VAL CANADA LTD. • 4687 Christie Drive • Beamsville, Ontario, LOR 1B4 Canada • (905) 563-4963


CLA-VAL CO.

NEWPORT BEACH, CALIFORNIA

CATALOG NO.

94-01/694-01

DRAWING NO.

76557

REV.

K

TYPE OF VALVE AND MAIN FEATURES

COMBINATION PRESSURE REDUCING AND SURGE CONTROL VALVE

DESIGN

DRAWN DP

10-21-71

CHK'D MF

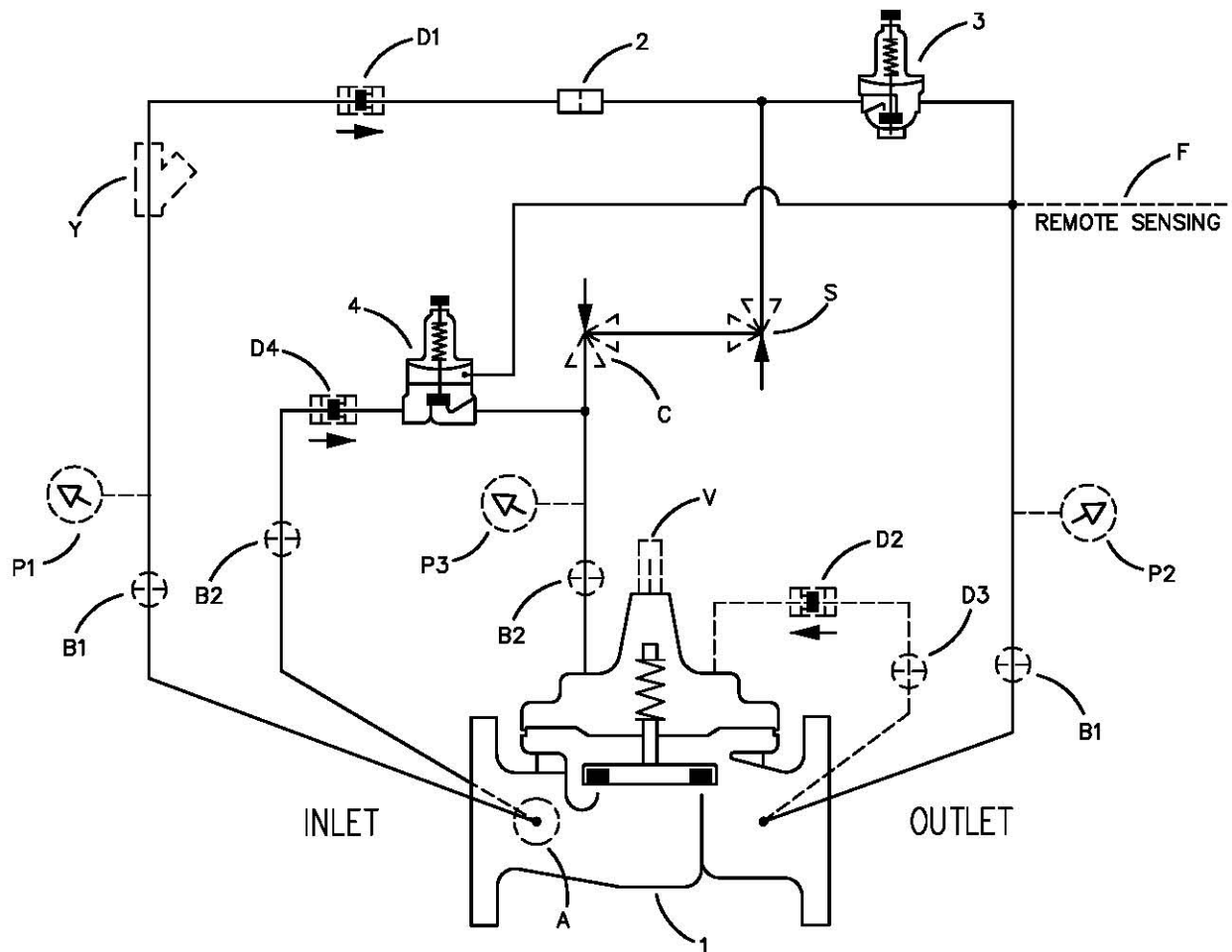
10-22-71

APVD JM

10-22-71

----- NOT FURNISHED BY CLA-VAL CO.

----- OPTIONAL FEATURES



ITEM NO.	BASIC COMPONENTS	QTY
1	100-01 HYTROL (94-01) MAIN VALVE 100-20 HYTROL (694-01) MAIN VALVE	1
2	X58C RESTRICTION ASSEMBLY	1
3	CRD PRESSURE REDUCING CONTROL	1
4	CRL PRESSURE RELIEF CONTROL (REV. FLOW)	1

OPTIONAL FEATURE SUFFIX			ADDED TO CATALOG NUMBER		
A	X46A FLOW CLEAN STRAINER	1	S	CV FLOW CONTROL (OPENING)	1
B	CK2 COCK (ISOLATION VALVE)	4	V	X101 VALVE POSITION INDICATOR	1
C	CV FLOW CONTROL (CLOSING)	1	Y	X43 "Y" STRAINER	1
D	CHECK VALVES WITH COCK	1			
F	REMOTE PILOT SENSING				
P	X141 PRESSURE GAUGE	3			

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& REDRAWN ON CAD (ECO 14041)

H ADDED OPTIONAL FEATURE "F" (ECO 16439)

J ADDED OPTIONAL FEATURE "D4" (ECO 20820)

K ADDED OPTIONAL FEATURES P & V (ECO 21821)

CAD REVISION RECORD - DO NOT REVISE MANUALLY

DESCRIPTION

A-F SEE REVISION FILE

G COMBINE 94-01 & 694-01 SCH'S ON TO DWG NO 76557

BY

DATE

LTR

**CLA-VAL CO.**

NEWPORT BEACH, CALIFORNIA

CATALOG NO.

94-01/694-01

DRAWING NO.

76557

REV.

K

TYPE OF VALVE AND MAIN FEATURES

COMBINATION PRESSURE REDUCING AND SURGE CONTROL VALVE

DESIGN

DRAWN

DP

10-21-71

CHK'D

MF

10-22-71

APVD

JM

10-22-71

OPERATING DATA

I. PRESSURE REDUCING FEATURE:

PRESSURE REDUCING CONTROL (3) IS A NORMALLY OPEN CONTROL THAT SENSES MAIN VALVE OUTLET PRESSURE CHANGES. AN INCREASE IN OUTLET PRESSURE TENDS TO CLOSE CONTROL (3) AND A DECREASE IN OUTLET PRESSURE TENDS TO OPEN CONTROL (3). THIS CAUSES MAIN VALVE COVER PRESSURE TO VARY AND THE MAIN VALVE MODULATES (OPENS AND CLOSES) MAINTAINING A RELATIVELY CONSTANT OUTLET PRESSURE.

PRESSURE REDUCING CONTROL (3) ADJUSTMENT: TURN THE ADJUSTING SCREW CLOCKWISE TO INCREASE THE SETTING.

II. SURGE CONTROL FEATURE:

PRESSURE RELIEF CONTROL (4) IS A NORMALLY CLOSED CONTROL THAT RESPONDS TO PRESSURE CHANGES SENSED DOWNSTREAM. WHEN DOWNSTREAM PRESSURE INCREASES TO THE SET POINT OF CONTROL (4), CONTROL (4) OPENS. THIS DIRECTS INLET PRESSURE INTO THE MAIN VALVE COVER AND THE MAIN VALVE CLOSSES UNTIL NORMAL DOWNSTREAM PRESSURE IS RESTORED AND PRESSURE RELIEF CONTROL (4) CLOSSES. PRESSURE RELIEF CONTROL (4) ADJUSTMENT: TURN THE ADJUSTING SCREW CLOCKWISE TO INCREASE THE SETTING.

III. OPTIONAL FEATURE OPERATING DATA:

SUFFIX A (FLOW CLEAN STRAINER)

A SELF-CLEANING STRAINER IS INSTALLED IN THE MAIN VALVE INLET BODY BOSS WHICH PROTECTS THE PILOT SYSTEM FROM FOREIGN PARTICLES.

SUFFIX B (ISOLATION VALVES)

CK2 COCKS (B1) & (B2) ARE USED TO ISOLATE THE PILOT SYSTEM FROM MAIN LINE PRESSURE. THESE VALVES MUST BE OPEN DURING NORMAL OPERATION.

SUFFIX C (CLOSING SPEED CONTROL)

CV FLOW CONTROL (C) CONTROLS THE CLOSING SPEED OF THE MAIN VALVE. TURN THE ADJUSTING STEM CLOCKWISE TO MAKE THE MAIN VALVE CLOSE SLOWER.

SUFFIX D (CHECK VALVES WITH COCK)

WHEN OUTLET PRESSURE IS HIGHER THAN INLET PRESSURE, CHECK VALVE (D2) OPENS AND (D1) & (D4) CLOSSES. THIS DIRECTS THE HIGHER OUTLET PRESSURE INTO THE MAIN VALVE COVER AND THE MAIN VALVE CLOSSES.

CAD REMISION RECORD - DO NOT REVISE MANUALLY

DESCRIPTION

DATE

BY

SEE SHEET 1

LTR

**CLA-VAL CO.**

NEWPORT BEACH, CALIFORNIA

CATALOG NO.

94-01/694-01

DRAWING NO.

76557

REV.

K

TYPE OF VALVE AND MAIN FEATURES

COMBINATION PRESSURE REDUCING AND SURGE CONTROL VALVE

DESIGN

DRAWN

DP

10-21-71

CHK'D

MF

10-22-71

APVD

JM

10-22-71

OPERATING DATA-CONTINUED

SUFFIX F (REMOTE PILOT SENSING)

PILOT SENSING PRESSURE IS OBTAINED FROM A REMOTE DOWNSTREAM LOCATION. [PILOT SENSING PRESSURE IS OBTAINED FROM THE MAIN VALVE OUTLET IF SUFFIX (F) IS NOT SPECIFIED].

SUFFIX P (PRESSURE GAUGE):

PRESSURE GAUGES (P) PROVIDE PRESSURE READING IN THE INLET, OUTLET AND COVER CONNECTIONS.

SUFFIX S (OPENING SPEED CONTROL)

CV FLOW CONTROL (S) CONTROLS THE OPENING SPEED OF THE MAIN VALVE. TURN THE ADJUSTING STEM CLOCKWISE TO MAKE THE MAIN VALVE OPEN SLOWER.

SUFFIX V (VALVE POSITION INDICATOR):

VALVE POSITION INDICATOR (V) DISPLAYS A VISUAL POSITION OF THE MAIN VALVE STEM.

SUFFIX Y (Y-STRAINER)

A Y-PATTERN STRAINER IS INSTALLED IN THE PILOT SUPPLY LINE TO PROTECT THE PILOT SYSTEM FROM FOREIGN PARTICLES. THE STRAINER SCREEN MUST BE CLEANED PERIODICALLY.

IV. CHECK LIST FOR PROPER OPERATION:

- () SYSTEM VALVES OPEN UPSTREAM AND DOWNSTREAM.
- () AIR REMOVED FROM THE MAIN VALVE COVER AND PILOT SYSTEM AT ALL HIGH POINTS.
- () CK2 COCKS (B1), (B2) & (D3) OPEN (OPTIONAL FEATURE).
- () PERIODIC CLEANING OF STRAINER (Y) IS RECOMMENDED (OPTIONAL FEATURE).
- () CV FLOW CONTROLS (C) & (S) OPEN AT LEAST 4 TURNS (OPTIONAL FEATURE).

CAD REMISION RECORD - DO NOT REVISE MANUALLY

DESCRIPTION

DATE

BY

SEE SHEET 1

LTR



94-01
(Full Internal Port)
MODEL
694-01
(Reduced Internal Port)

Combination Pressure Reducing and Surge Control Valve



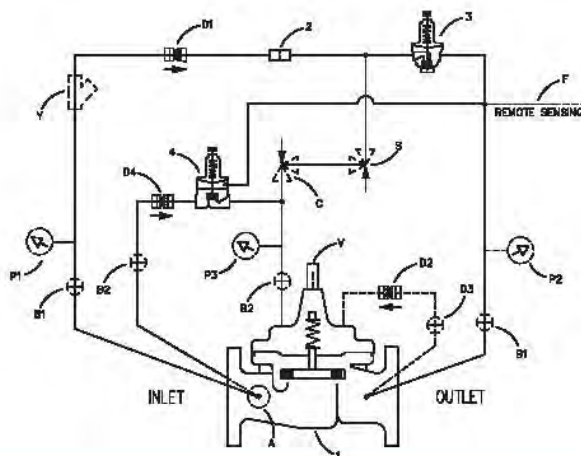
Schematic Diagram

Item	Description
1	100-01Hytrol (Main Valve)
2	X58C Restriction Assembly
3	CRD Pressure Reducing Control
4	CRL Pressure Relief Control

Optional Features

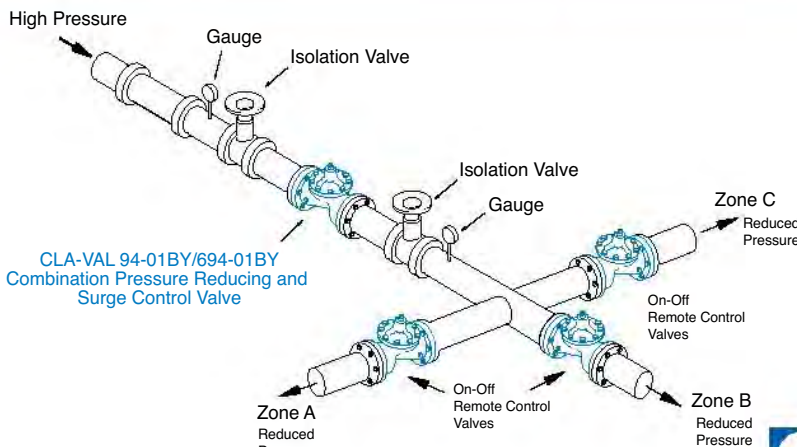
Item	Description
A	X46A Flow Clean Strainer
B	CK2 (Isolation Valve)
C	CV Flow Control (Closing)*
D	Check Valves with Isolation Valve
F	Remote Pilot Sensing
P	X141 Pressure Gauge
S	CV Speed Control (Opening)
V	X101 Valve Position Indicator
Y	X43 "Y" Strainer

*The closing speed control (optional) on this valve should always be open at least three (3) turns off its seat.



Typical Application

Should the downstream pressure suddenly increase above the setting of the pressure reducing control due to on-off operation of two or more downstream systems, the Surge Control tracks rapidly enough to prevent high pressure surges from entering any of the downstream systems, when any one of the downstream systems is rapidly closed off. The typical combination pressure reducing and surge control valve station uses Model 94-01BY/694-01BY to control surges in downstream piping as remote control valves change from one downstream zone to another. Surge Control is set approximately 10 psi above Pressure Reducing Control to prevent high pressure surge entering other downstream zones.



Model 94-01 (Uses Basic Valve Model 100-01)

Pressure Ratings (Recommended Maximum Pressure - psi)

Valve Body & Cover		Pressure Class				
		Flanged			Grooved	Threaded
Grade	Material	ANSI Standards*	150 Class	300 Class	300 Class	End† Details
ASTM A536	Ductile Iron	B16.42	250	400	400	400
ASTM A216-WCB	Cast Steel	B16.5	285	400	400	400
ASTM B62	Bronze	B16.24	225	400	400	400

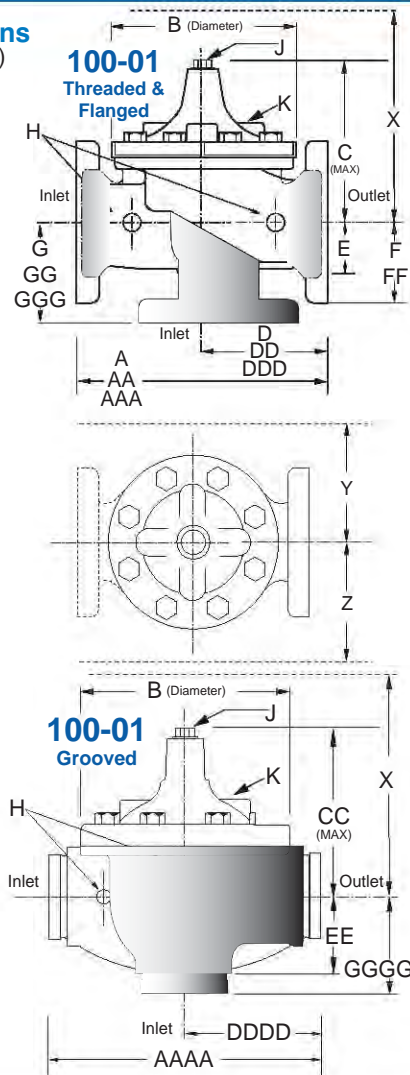
Note: * ANSI standards are for flange dimensions only.
 Flanged valves are available faced but not drilled.
 † End Details machined to ANSI B2.1 specifications.
Valves for higher pressure are available; consult factory for details

Materials

Component	Standard Material Combinations		
Body & Cover	Ductile Iron	Cast Steel	Bronze
Available Sizes	1" - 36"	1" - 16"	1" - 16"
Disc Retainer & Diaphragm Washer	Cast Iron	Cast Steel	Bronze
Trim: Disc Guide, Seat & Cover Bearing	Bronze is Standard Stainless Steel is Optional		
Disc	Buna-N® Rubber		
Diaphragm	Nylon Reinforced Buna-N® Rubber		
Stem, Nut & Spring	Stainless Steel		

For material options not listed, consult factory.
 Cla-Val manufactures valves in more than 50 different alloys.

Dimensions (In inches)



Model 94-01 Dimensions (In Inches)

Valve Size (Inches)	1	1 1/4	1 1/2	2	2 1/2	3	4	6	8	10	12	14	16	18	20	24	30	36
A Threaded	7.25	7.25	7.25	9.38	11.00	12.50	—	—	—	—	—	—	—	—	—	—	—	—
AA 150 ANSI	—	—	8.50	9.38	11.00	12.00	15.00	20.00	25.38	29.75	34.00	39.00	41.38	46.00	52.00	61.50	63.00	76.00
AAA 300 ANSI	—	—	9.00	10.00	11.62	13.25	15.62	21.00	26.38	31.12	35.50	40.50	43.50	47.64	53.62	63.24	64.50	76.00
AAAA Grooved End	—	—	8.50	9.00	11.00	12.50	15.00	20.00	25.38	—	—	—	—	—	—	—	—	—
B Dia.	5.62	5.62	5.62	6.62	8.00	9.12	11.50	15.75	20.00	23.62	28.00	32.75	35.50	41.50	45.00	53.16	56.00	66.00
C Max.	5.50	5.50	5.50	6.50	7.56	8.19	10.62	13.38	16.00	17.12	20.88	24.19	25.00	39.06	41.90	43.93	54.60	61.50
CC Max. Grooved End	—	—	4.75	5.75	6.88	7.25	9.31	12.12	14.62	—	—	—	—	—	—	—	—	—
D Threaded	3.25	3.25	3.25	4.75	5.50	6.25	—	—	—	—	—	—	—	—	—	—	—	—
DD 150 ANSI	—	—	4.00	4.75	5.50	6.00	7.50	10.00	12.69	14.88	17.00	19.50	20.81	—	—	30.75	—	—
DDD 300 ANSI	—	—	4.25	5.00	5.88	6.38	7.88	10.50	13.25	15.56	17.75	20.25	21.62	—	—	31.62	—	—
DDDD Grooved End	—	—	—	4.75	—	6.00	7.50	—	—	—	—	—	—	—	—	—	—	—
E	1.12	1.12	1.12	1.50	1.69	2.06	3.19	4.31	5.31	9.25	10.75	12.62	15.50	12.95	15.00	17.75	21.31	24.56
EE Grooved End	—	—	2.00	2.50	2.88	3.12	4.25	6.00	7.56	—	—	—	—	—	—	—	—	—
F 150 ANSI	—	—	2.50	3.00	3.50	3.75	4.50	5.50	6.75	8.00	9.50	10.50	11.75	15.00	16.50	19.25	22.50	25.60
FF 300 ANSI	—	—	3.06	3.25	3.75	4.13	5.00	6.25	7.50	8.75	10.25	11.50	12.75	15.00	16.50	19.25	24.00	25.60
G Threaded	1.88	1.88	1.88	3.25	4.00	4.50	—	—	—	—	—	—	—	—	—	—	—	—
GG 150 ANSI	—	—	4.00	3.25	4.00	4.00	5.00	6.00	8.00	8.62	13.75	14.88	15.69	—	—	22.06	—	—
GGG 300 ANSI	—	—	4.25	3.50	4.31	4.38	5.31	6.50	8.50	9.31	14.50	15.62	16.50	—	—	22.90	—	—
GGGG Grooved End	—	—	—	3.25	—	4.25	5.00	—	—	—	—	—	—	—	—	—	—	—
H NPT Body Tapping	.375	.375	.375	.375	.50	.50	.75	.75	1	1	1	1	1	1	1	1	2	2
J NPT Cover Center Plug	.25	.25	.25	.50	.50	.50	.75	.75	1	1	1.25	1.5	2	1.5	1.5	1.5	2	2
K NPT Cover Tapping	.375	.375	.375	.375	.50	.50	.75	.75	1	1	1	1	1	1	1	1	2	2
Stem Travel	0.4	0.4	0.4	0.6	0.7	0.8	1.1	1.7	2.3	2.8	3.4	4.0	4.5	5.1	5.63	6.75	7.5	8.5
Approx. Ship Wt. Lbs.	15	15	15	35	50	70	140	285	500	780	1165	1600	2265	2982	3900	6200	7703	11720
X Pilot System	11	11	11	13	14	15	17	29	31	33	36	40	40	43	47	68	79	85
Y Pilot System	9	9	9	9	10	11	12	20	22	24	26	29	30	32	34	39	40	45
Z Pilot System	9	9	9	9	10	11	12	20	22	24	26	29	30	32	34	39	42	47

Note: The top two flange holes on valve size 36 are threaded to 1 1/2"-6 UNC.

Model 694-01 (Uses Basic Valve Model 100-20)

Dimensions (In inches)

Pressure Ratings (Recommended Maximum Pressure - psi)

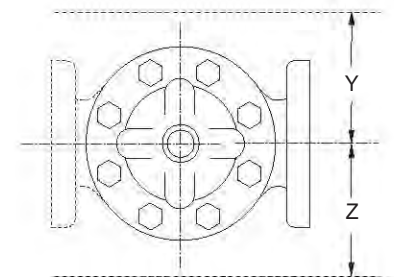
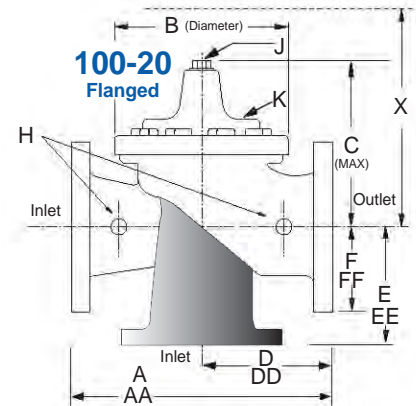
Valve Body & Cover		Pressure Class		
		Flanged		
Grade	Material	ANSI Standards*	150 Class	300 Class
ASTM A536	Ductile Iron	B16.42	250	400
ASTM A216-WCB	Cast Steel	B16.5	285	400
ASTM B62	Bronze	B16.24	225	400

Note: * ANSI standards are for flange dimensions only.
Flanged valves are available faced but not drilled.
Valves for higher pressure are available; consult factory for details

Materials

Component	Standard Material Combinations		
Body & Cover	Ductile Iron	Cast Steel	Bronze
Available Sizes	3" - 48"	3" - 16"	3" - 16"
Disc Retainer & Diaphragm Washer	Cast Iron	Cast Steel	Bronze
Trim: Disc Guide, Seat & Cover Bearing	Bronze is Standard Stainless Steel is Optional		
Disc	Buna-N® Rubber		
Diaphragm	Nylon Reinforced Buna-N® Rubber		
Stem, Nut & Spring	Stainless Steel		

For material options not listed, consult factory.
Cla-Val manufactures valves in more than 50 different alloys.



Model 694-01 Dimensions (In Inches)

Valve Size (Inches)	3	4	6	8	10	12	14	16	18	20	24	30	36	42	48
A 150 ANSI	10.25	13.88	17.75	21.38	26.00	30.00	34.25	35.00	42.12	48.00	48.00	63.25	65.00	76.00	94.50
AA 300 ANSI	11.00	14.50	18.62	22.38	27.38	31.50	35.75	36.62	43.63	49.62	49.75	63.75	67.00	76.00	94.50
B Dia.	6.62	9.12	11.50	15.75	20.00	23.62	27.47	28.00	35.44	35.44	35.44	53.19	56.00	66.00	66.00
C Max.	7.00	8.62	11.62	15.00	17.88	21.00	20.88	25.75	25.00	31.00	31.00	43.94	54.60	61.50	61.50
D 150 ANSI	—	6.94	8.88	10.69	CF*	CF*	CF*	CF*	CF*	CF*	CF*	—	—	—	—
DD 300 ANSI	—	7.25	9.38	11.19	CF*	CF*	CF*	CF*	CF*	CF*	CF*	—	—	—	—
E 150 ANSI	—	5.50	6.75	7.25	CF*	CF*	CF*	CF*	CF*	CF*	CF*	—	—	—	—
EE 300 ANSI	—	5.81	7.25	7.75	CF*	CF*	CF*	CF*	CF*	CF*	CF*	—	—	—	—
F 150 ANSI	3.75	4.50	5.50	6.75	8.00	9.50	11.00	11.75	15.88	14.56	17.00	19.88	25.50	28.00	31.50
FF 300 ANSI	4.12	5.00	6.25	7.50	8.75	10.25	11.50	12.75	15.88	16.06	19.00	22.00	27.50	28.00	31.50
H NPT Body Tapping	.375	.50	.75	.75	1	1	1	1	1	1	1	1	2	2	2
J NPT Cover Center Plug	.50	.50	.75	.75	1	1	1.25	1.25	2	2	2	2	2	2	2
K NPT Cover Tapping	.375	.50	.75	.75	1	1	1	1	1	1	1	1	2	2	2
Stem Travel	0.6	0.8	1.1	1.7	2.3	2.8	3.4	3.4	3.4	4.5	4.5	6.5	7.5	8.5	8.5
Approx. Ship Wt. Lbs.	45	85	195	330	625	900	1250	1380	1500	2551	2733	6500	8545	12450	13100
X Pilot System	13	15	27	30	33	36	36	41	40	46	55	68	79	85	86
Y Pilot System	10	11	18	20	22	24	26	26	30	30	30	39	40	45	47
Z Pilot System	10	11	18	20	22	24	26	26	30	30	30	39	42	47	49

*Consult Factory

Note: The top two flange holes on valve sizes 36 thru 48 are threaded to 1 1/2"-6 UNC.

94-01 Valve Selection	100-01 Pattern: Globe (G), Angle (A), End Connections: Threaded (T), Grooved (GR), Flanged (F) Indicate Available Sizes																		
	Inches	1	1½	1½	2	2½	3	4	6	8	10	12	14	16	18	20	24	30	36
	mm	25	32	40	50	65	80	100	150	200	250	300	350	400	450	500	600	750	900
Basic Valve 100-01	Pattern	G, A	G, A	G, A	G, A	G, A	G, A	G, A	G, A	G, A	G, A	G, A	G, A	G, A	G	G	G, A	G	G
	End Detail	T	T	T, F, Gr*	T, F, Gr	T, F, Gr*	T, F, Gr	F, Gr	F, Gr*	F, Gr*	F	F	F	F	F	F	F	F	F
Suggested Flow (gpm)	Maximum	55	93	125	210	300	460	800	1800	3100	4900	7000	8400	11000	14000	17000	25000	42000	50000
	Maximum Intermittent	68	120	160	260	370	580	990	2250	3900	6150	8720	10540	13700	17500	21700	31300	48000	62500
	Minimum	1	1	1	1	2	2	4	10	15	35	50	70	95	120	150	275	450	650
Suggested Flow (Liters/Sec)	Maximum	3.5	6	8	13	19	29	50	113	195	309	442	530	694	883	1073	1577	2650	3150
	Maximum Intermittent	4.3	7.6	10	16	23	37	62	142	246	387	549	664	863	1104	1369	1972	3028	3940
	Minimum	.03	.03	.03	.06	.09	0.13	0.25	0.63	0.95	2.2	3.2	4.4	6.0	7.6	9.5	17.4	28.4	41.0
100-01 Series is the full internal port Hytrol. For Lower Flows Consult Factory																			*Globe Grooved Only

694-01 Valve Selection	100-20 Pattern: Globe (G), Angle (A), End Connections: Flanged (F) Indicate Available Sizes															
	Inches	3	4	6	8	10	12	14	16	18	20	24	30	36	42	48
	mm	80	100	150	200	250	300	350	400	450	500	600	750	900	1000	1200
Basic Valve 100-20	Pattern	G	G, A	G, A	G, A	G	G	G	G	G	G	G	G	G	G	G
	End Detail	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
Suggested Flow (gpm)	Maximum	260	580	1025	2300	4100	6400	9230	9230	16500	16500	16500	28000	33500	33500	33500
	Minimum	1	2	4	10	15	35	50	50	95	95	95	275	450	450	450
Suggested Flow (Liters/Sec)	Maximum	16	37	65	145	258	403	581	581	1040	1040	1040	1764	2115	2115	2115
	Minimum	.06	.13	.25	.63	.95	2.2	3.2	3.2	6.0	6.0	6.0	17.4	28.4	41.0	41.0
100-20 Series is the reduced internal port size version of the 100-01 Series. For Lower Flows Consult Factory																

Many factors should be considered in sizing pressure reducing valves including inlet pressure, outlet pressure and flow rates.
For sizing questions or cavitation analysis, consult Cla-Val with system details.

Pilot System Specifications

Adjustment Ranges

CRD	CRL
2 to 30 psi	0 to 75 psi
15 to 75 psi	20 to 105 psi*
20 to 105 psi	20 to 200 psi
30 to 300 psi*	100 to 300 psi

*Supplied unless otherwise specified
Other ranges available, please consult factory.

Temperature Range

Water: to 180°F

Temperature Range

Water: to 180°F

Materials

Standard Pilot System Materials

Pilot Control: Bronze ASTM B62
Trim: Stainless Steel Type 303
Rubber: Buna-N® Synthetic Rubber

Optional Pilot System Materials

Pilot Systems are available with optional
Aluminum, Stainless Steel, Monel or
Cast Steel materials.

Note: Available with remote sensing control.

When Ordering, Please Specify

1. Catalog No. 94-01 or No. 694-01
2. Valve Size
3. Pattern - Globe or Angle
4. Pressure Class
5. Threaded or Flanged
6. Trim Material
7. Adjustment Range
8. Desired Options
9. When Vertically Installed

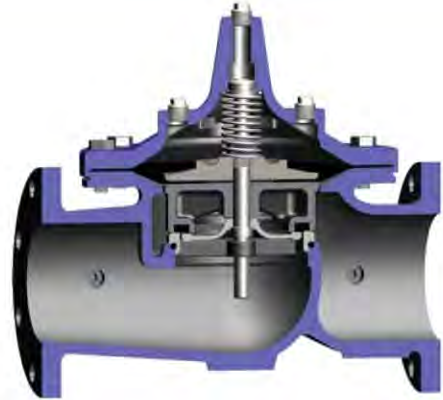


—MODEL— 100-01 Hytrol Valve

Description

The Cla-Val Model 100-01 Hytrol Valve is a main valve for Cla-Val Automatic Control Valves. It is a hydraulically operated, diaphragm-actuated, globe or angle pattern valve.

This valve consists of three major components; body, diaphragm assembly, and cover. The diaphragm assembly is the only moving part. The diaphragm assembly uses a diaphragm of nylon fabric bonded with synthetic rubber. A synthetic rubber disc, contained on three and one half sides by a disc retainer and disc guide, forms a seal with the valve seat when pressure is applied above the diaphragm. The diaphragm assembly forms a sealed chamber in the upper portion of the valve, separating operating pressure from line pressure.



Installation

1. Before valve is installed, pipe lines should be flushed of all chips, scale and foreign matter.
2. It is recommended that either gate or block valves be installed on both ends of the 100-01 Hytrol Valve to facilitate isolating the valve for preventive maintenance and repairs.
3. Place the valve in the line with flow through the valve in the direction indicated on the inlet nameplate. (See "Flow Direction" Section)
4. Allow sufficient room around valve to make adjustments and for disassembly.
5. Cla-Val 100-01 Hytrol Valves operate with maximum efficiency when mounted in horizontal piping with the cover UP, however, other positions are acceptable. Due to size and weight of the cover and internal components of 8 inch and larger valves,

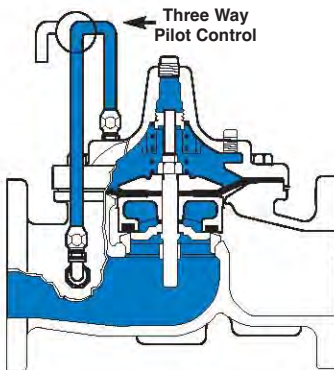
installation with the cover UP is advisable. This makes internal parts readily accessible for periodic inspection.

6. Caution must be taken in the installation of this valve to insure that galvanic and/or electrolytic action does not take place. The proper use of dielectric fittings and gaskets are required in all systems using dissimilar metals.

7. If a pilot control system is installed on the 100-01 Hytrol Valve, use care to prevent damage. If it is necessary to remove fittings or components, be sure they are kept clean and replaced exactly as they were.

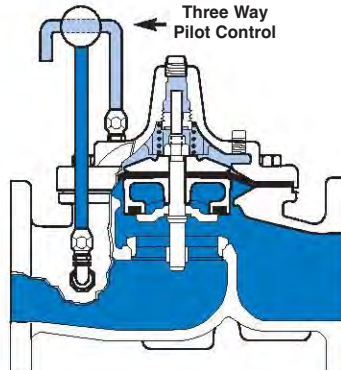
8. After the valve is installed and the system is first pressurized, vent air from the cover chamber and pilot system tubing by loosening fittings at all high points.

Principles of Operation



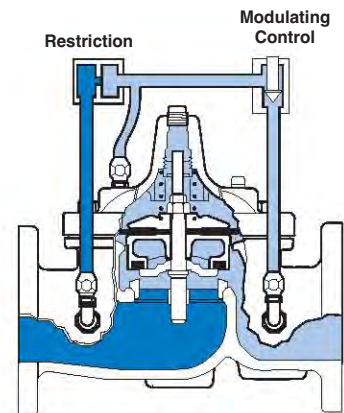
Tight Closing Operation

When pressure from the valve inlet (or an equivalent independent operating pressure) is applied to the diaphragm chamber the valve closes drip-tight.



Full Open Operation

When pressure in diaphragm chamber is relieved to a zone of lower pressure (usually atmosphere) the line pressure (5 psi Min.) at the valve inlet opens the valve.



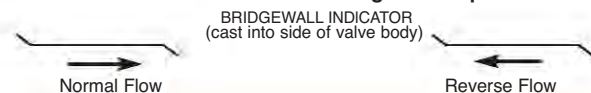
Modulating Action

Valve modulates when diaphragm pressure is held at an intermediate point between inlet and discharge pressure. With the use of a Cla-Val. "modulating control," which reacts to line pressure changes, the pressure above the diaphragm is varied, allowing the valve to throttle and compensate for the change.

Flow Direction

The flow through the 100-01 Hytrol Valve can be in one of two directions. When flow is "up-and-over the seat," it is in "normal" flow and the valve will fail in the open position. When flow is "over-the seat-and down," it is in "reverse" flow and the valve will fail in the closed position. There are no permanent flow arrow markings.

The valve must be installed according to nameplate data.



Recommended Tools

1. Three pressure gauges with ranges suitable to the installation to be put at Hytrol inlet, outlet and cover connections.
2. Cla-Val Model X101 Valve Position Indicator. This provides visual indication of valve position without disassembly of valve.
3. Other items are: suitable hand tools such as screwdrivers, wrenches, etc. soft jawed (brass or aluminum) vise, 400 grit wet or dry sandpaper and water for cleaning.

Troubleshooting

The following troubleshooting information deals strictly with the Model 100-01 Hytrol Valve. This assumes that all other components of the pilot control system have been checked out and are in proper working condition. (See appropriate sections in Technical Manual for complete valve).

All trouble shooting is possible without removing the valve from the line or removing the cover. It is highly recommended to permanently install a Model X101 Valve Position Indicator and three gauges in unused Hytrol inlet, outlet and cover connections.

SYMPTOM	PROBABLE CAUSE	REMEDY
Fails to Close	Closed isolation valves in control system, or in main line.	Open Isolation valves.
	Lack of cover chamber pressure.	Check upstream pressure, pilot system, strainer, tubing, valves, or needle valves for obstruction.
	Diaphragm damaged. (See Diaphragm Check.)	Replace diaphragm.
	Diaphragm assembly inoperative. Corrosion or excessive scale build up on valve stem. (See Freedom of Movement Check)	Clean and polish stem. Inspect and replace any damaged or badly eroded part.
	Mechanical obstruction. Object lodged in valve. (See Freedom of Movement Check)	Remove obstruction.
	Worn disc. (See Tight Sealing Check)	Replace disc.
	Badly scored seat. (See Tight Sealing Check)	Replace seat.
Fails to Open	Closed upstream and/or downstream isolation valves in main line.	Open isolation valves.
	Insufficient line pressure.	Check upstream pressure. (Minimum 5 psi flowing line pressure differential.)
	Diaphragm assembly inoperative. Corrosion or excessive buildup on valve stem. (See Freedom of Movement Check)	Clean and polish stem. Inspect and replace any damaged or badly eroded part.
	Diaphragm damaged. (For valves in "reverse flow" only)	Replace diaphragm.

After checking out probable causes and remedies, the following three checks can be used to diagnose the nature of the problem before maintenance is started. They must be done in the order shown.

Three Checks

The 100-01 Hytrol Valve has only one moving part (the diaphragm and disc assembly). So, there are only three major types of problems to be considered.

First: Valve is stuck - that is, the diaphragm assembly is not free to move through a full stroke either from open to close or vice versa.

Second: Valve is free to move and can't close because of a worn out diaphragm.

Third: Valve leaks even though it is free to move and the diaphragm isn't leaking.

CAUTION:

*Care should be taken when doing the troubleshooting checks on the 100-01 Hytrol Valve. These checks do require the valve to open fully. This will either allow a high flow rate through the valve, or the downstream pressure will quickly increase to the inlet pressure. In some cases, this can be very harmful. Where this is the case, and there are no block valves in the system to protect the downstream piping, it should be realized that **the valve cannot be serviced under pressure**. Steps should be taken to remedy this situation before proceeding any further.*

Diaphragm Check (#1)

1. Shut off pressure to the Hytrol Valve by slowly closing upstream and downstream isolation valves. **SEE CAUTION.**
2. Disconnect or close all pilot control lines to the valve cover and leave only one fitting in highest point of cover open to atmosphere.
3. With the cover vented to atmosphere, slowly open upstream isolation valve to allow some pressure into the Hytrol Valve body. Observe the open cover tapping for signs of continuous flow. It is not necessary to fully open isolating valve. Volume in cover chamber capacity chart will be displaced as valve moves to open position. Allow sufficient time for diaphragm assembly to shift positions. If there is no continuous flow, you can be quite certain the diaphragm is sound and the diaphragm assembly is tight. If the fluid appears to flow continuously this is a good reason to believe the diaphragm is either damaged or it is loose on the stem. In either case, this is sufficient cause to remove the valve cover and investigate the leakage. (See "Maintenance" Section for procedure.)

COVER CHAMBER CAPACITY (Liquid Volume displaced when valve opens)

Valve size (inches)	Displacement	
	Gallons	Liters
1 1/4	.020	.07
1 1/2	.020	.07
2	.032	.12
2 1/2	.043	.16
3	.080	.30
4	.169	.64
6	.531	2.0
8	1.26	4.8
10	2.51	9.5
12	4.00	15.1
14	6.50	24.6
16	9.57	36.2
20	12.00	45.4
24	29.00	109.8
30	42.00	197.0
36	90.00	340.0

Freedom of Movement Check (#2)

4. Determining the Hytrol Valve's freedom of movement can be done by one of two methods.
5. For most valves it can be done after completing Diaphragm Check (Steps 1, 2, and 3). **SEE CAUTION.** At the end of step 3 the valve should be fully open.
6. If the valve has a Cla-Val X101 Position Indicator, observe the indicator to see that the valve opens wide. Mark the point of maximum opening.
7. Re-connect enough of the control system to permit the application of inlet pressure to the cover. Open pilot system cock so pressure flows from the inlet into the cover.
8. While pressure is building up in the cover, the valve should close smoothly. There is a hesitation in every Hytrol Valve closure, which can be mistaken for a mechanical bind. The stem will appear to stop moving very briefly before going to the closed position. This slight pause is caused by the diaphragm flexing at a particular point in the valve's travel and is not caused by a mechanical bind.
9. When closed, a mark should be made on the X101 Valve position indicator corresponding to the "closed" position. The distance between the two marks should be approximately the stem travel shown in chart.

STEM TRAVEL

(Fully Open to Fully Closed)

Valve Size (inches)		Travel (inches)	
Inches	MM	Inches	MM
1 1/4	32	0.4	10
1 1/2	40	0.4	10
2	50	0.6	15
2 1/2	65	0.7	18
3	80	0.8	20
4	100	1.1	28
6	150	1.7	43
8	200	2.3	58
10	250	2.8	71
12	300	3.4	86
14	350	4.0	100
16	400	4.5	114
20	500	5.6	143
24	600	6.7	165
30	800	7.5	190
36	900	8.5	216

10. If the stroke is different than that shown in stem travel chart this is a good reason to believe something is mechanically restricting the stroke of the valve at one end of its travel. If the flow does not stop through the valve when in the indicated "closed" position, the obstruction probably is between the disc and the seat. If the flow does stop, then the obstruction is more likely in the cover. In either case, the cover must be removed, and the obstruction located and removed. The stem should also be checked for scale build-up. (See "Maintenance, section for procedure.)

11. For valves 6" and smaller, the Hytrol Valve's freedom of movement check can also be done after all pressure is removed from the valve. **SEE CAUTION.** After closing inlet and outlet isolation valves and bleeding pressure from the valve, check that the cover chamber and the body are temporarily vented to atmosphere. Insert fabricated tool into threaded hole in top of valve stem, and lift the diaphragm assembly manually. Note any roughness. The diaphragm assembly should move smoothly throughout entire valve stroke. The tool is fabricated from rod that is threaded on one end to fit valve stem and has a "T" bar handle of some kind on the other end for easy gripping. (See chart in Step 4 of "Disassembly" Section.)

12. Place marks on this diaphragm assembly lifting tool when the valve is closed and when manually positioned open. The distance between the two marks should be approximately the stem travel shown in stem travel chart. If the stroke is different than that shown, there is a good reason to believe something is mechanically restricting the stroke of the valve. The cover must be removed, and the obstruction located and removed. The stem should also be checked for scale build-up. (See "Maintenance" Section for procedure.)

Tight Sealing Check (#3)

13. Test for seat leakage after completing checks #1 & #2 (Steps 1 to 12). **SEE CAUTION.** Close the isolation valve downstream of the Hytrol Valve. Apply inlet pressure to the cover of the valve, wait until it closes. Install a pressure gauge between the two closed valves using one of the two ports in the outlet side of the Hytrol. Watch the pressure gauge. If the pressure begins to climb, then either the downstream isolation valve is permitting pressure to creep back, or the Hytrol is allowing pressure to go through it. Usually the pressure at the Hytrol inlet will be higher than on the isolation valve discharge, so if the pressure goes up to the inlet pressure, you can be sure the Hytrol is leaking. Install another gauge downstream of isolating valve. If the pressure between the valves only goes up to the pressure on the isolation valve discharge, the Hytrol Valve is holding tight, and it was just the isolation valve leaking.

Maintenance

Preventative Maintenance

The Cla-Val Co. Model 100-01 Hytrol Valve requires no lubrication or packing and a minimum of maintenance. However, a periodic inspection schedule should be established to determine how the operating conditions of the system are affecting the valve. The effect of these actions must be determined by inspection.

Disassembly

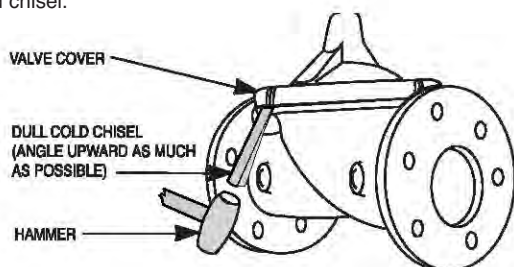
Inspection or maintenance can be accomplished without removing the valve from the line. Repair kits with new diaphragm and disc are recommended to be on hand before work begins.

WARNING: Maintenance personnel can be injured and equipment damaged if disassembly is attempted with pressure in the valve. **SEE CAUTION.**

1. Close upstream and downstream isolation valves **and independent operating pressure when used** to shut off all pressure to the valve.

2. Loosen tube fittings in the pilot system to remove pressure from valve body and cover chamber. After pressure has been released from the valve, use care to remove the controls and tubing. Note and sketch position of tubing and controls for re-assembly. The schematic in front of the Technical Manual can be used as a guide when reassembling pilot system.

3. Remove cover nuts and remove cover. If the valve has been in service for any length of time, chances are the cover will have to be loosened by driving upward along the edge of the cover with a **dull** cold chisel.



On 6" and smaller valves block and tackle or a power hoist can be used to lift valve cover by inserting proper size eye bolt in place of the center cover plug. On 8" and larger valves there are 4 holes (5/8" — 11 size) where jacking screws and/or eye bolts may be inserted for lifting purposes. **Pull cover straight up** to keep from damaging the integral seat bearing and stem.

COVER CENTER PLUG SIZE

Valve Size	Thread Size (NPT)
1 1/4" — 1 1/2"	1/4"
2" — 3"	1/2"
4" — 6"	3/4"
8" — 10"	1"
12"	1 1/4"
14"	1 1/2"
16"	2"
20" & 24"	2"
30" & 36"	2"

4. Remove the diaphragm and disc assembly from the valve body. With smaller valves this can be accomplished by hand by **pulling straight up on the stem so as not to damage the seat bearing**. On large valves, an eye bolt of proper size can be installed in the stem and the diaphragm assembly can be then lifted with a block and tackle or power hoist. Take care not to damage the stem or bearings. The valve won't work if these are damaged.

VALVE STEM THREAD SIZE

Valve Size	Thread Size (UNF Internal)
1 1/4" — 2 1/2"	10 — 32
3" — 4"	1/4 — 28
6" — 14"	3/8 — 24
16"	1/2 — 20
20	3/4 — 16
24"	3/4 — 16
30"	3/4 — 16
36"	3/4 — 16

5. The next item to remove is the stem nut. Examine the stem threads above the nut for signs of mineral deposits or corrosion. If the threads are not clean, use a wire brush to remove as much of the residue as possible. Attach a good fitting wrench to the nut and give it a sharp "rap" rather than a steady pull. Usually several blows are sufficient to loosen the nut for further removal. On the smaller valves, the entire diaphragm assembly can be held by the stem in a vise **equipped with soft brass jaws** before removing the stem nut.

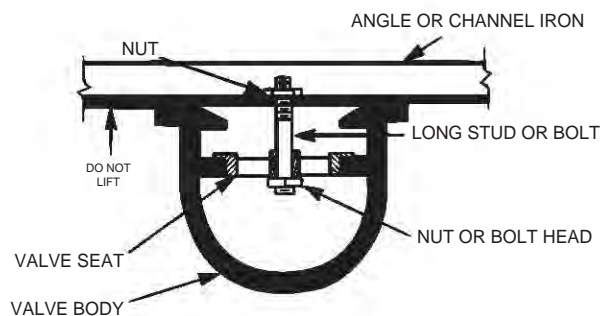
The use of a pipe wrench or a vise without soft brass jaws scars the fine finish on the stem. No amount of careful dressing can restore the stem to its original condition. Damage to the finish of the stem can cause the stem to bind in the bearings and the valve will not open or close.

6. After the stem nut has been removed, the diaphragm assembly breaks down into its component parts. Removal of the disc from the disc retainer can be a problem if the valve has been in service for a long time. Using two screwdrivers inserted along the outside edge of the disc usually will accomplish its removal. Care should be taken to preserve the spacer washers in water, particularly if no new ones are available for re-assembly.

7. The only part left in the valve body is the seat which ordinarily does not require removal. Careful cleaning and polishing of inside and outside surfaces with 400 wet/dry sandpaper will usually restore the seat's sharp edge. If, however, it is badly worn and replacement is necessary, it can be easily removed.

Seats in valve sizes 1 1/4" through 6" are threaded into the valve body. They can be removed with accessory X109 Seat Removing Tool available from the factory. On 8" and larger valves, the seat is held in place by flat head machine screws. Use a tight-fitting, long shank screwdriver to prevent damage to seat screws. If upon removal of the screws the seat cannot be lifted out, it will be necessary to use a piece of angle or channel iron with a hole drilled in the center. Place it across the body so a long stud can be inserted through the center hole in the seat and the hole in the angle iron. By tightening the nut a uniform upward force is exerted on the seat for removal.

NOTE: Do not lift up on the end of the angle iron as this may force the integral bearing out of alignment, causing the stem to bind.



Lime Deposits

One of the easiest ways to remove lime deposits from the valve stem or other metal parts is to dip them in a 5-percent muriatic acid solution just long enough for the deposit to dissolve. This will remove most of the common types of deposits. **CAUTION: USE EXTREME CARE WHEN HANDLING ACID.** Rinse parts in water before handling. If the deposit is not removed by acid, then a fine grit (400) wet or dry sandpaper can be used with water.

Inspection of Parts

After the valve has been disassembled, each part should be examined carefully for signs of wear, corrosion, or any other abnormal condition. Usually, it is a good idea to replace the rubber parts (diaphragm and disc) unless they are free of signs of wear. These are available in a repair kit. Any other parts which appear doubtful should be replaced. **WHEN ORDERING PARTS, BE SURE TO GIVE COMPLETE NAMEPLATE DATA, ITEM NUMBER AND DESCRIPTION.**

NOTE: If a new disc isn't available, the existing disc can be turned over, exposing the unused surface for contact with the seat. The disc should be replaced as soon as practical.

Reassembly

1. Reassembly is the reverse of the disassembly procedure. If a new disc has been installed, it may require a different number of spacer washers to obtain the right amount of "grip" on the disc. When the diaphragm assembly has been tightened to a point where the diaphragm cannot be twisted, the disc should be compressed very slightly by the disc guide. Excessive compression should be avoided. Use just enough spacer washers to hold the disc firmly without noticeable compression.

2. MAKE SURE THE STEM NUT IS VERY TIGHT. Attach a good fitting wrench to the nut and give it a sharp "rap" rather than a steady pull. Usually several blows are sufficient to tighten the stem nut for final tightening. Failure to do so could allow the diaphragm to pull loose and tear when subjected to pressure.

3. Carefully install the diaphragm assembly by lowering the stem through the seat bearing. Take care not to damage the stem or bearing. Line up the diaphragm holes with the stud or bolt holes on the body. On larger valves with studs, it may be necessary to hold the diaphragm assembly up part way while putting the diaphragm over the studs.

4. Put spring in place and replace cover. Make sure diaphragm is lying smooth under the cover.

5. Tighten cover nuts firmly using a cross-over pattern until all nuts are tight.

6. Test Hytrol Valve before re-installing pilot valve system.

Test Procedure After Valve Assembly

There are a few simple tests which can be made in the field to make sure the Hytrol Valve has been assembled properly. Do these before installing pilot system and returning valve to service. These are similar to the three troubleshooting tests.

1. Check the diaphragm assembly for freedom of movement after all pressure is removed from the valve. **SEE CAUTION.** Insert fabricated tool into threaded hole in top of valve stem, and lift the diaphragm assembly manually. Note any roughness, sticking or grabbing. The diaphragm assembly should move smoothly throughout entire valve stroke. The tool is fabricated from rod that is threaded on one end to fit valve stem (See chart in Step 4 of "Disassembly" section.) and has a "T" Bar handle of some kind on the other end for easy gripping.

Place marks on this diaphragm assembly lifting tool when the valve is closed and when manually positioned open. The distance between the two marks should be approximately the stem travel shown in stem travel chart. (See "Freedom of Movement Check" section.) If the stroke is different than that shown, there is a good reason to believe something is mechanically restricting the stroke of the valve. The cover must be removed, the obstruction located and removed. (See "Maintenance" Section for procedure.)

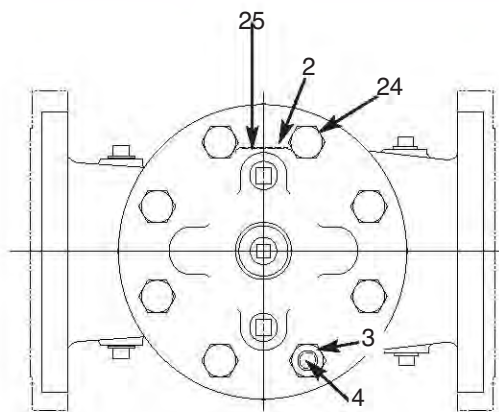
Due to the weight of the diaphragm assembly this procedure is not possible on valves 8" and larger. On these valves, the same determination can be made by carefully introducing a low pressure-less than five psi) into the valve body with the cover vented. **SEE CAUTION.** Looking in cover center hole see the diaphragm assembly lift easily without hesitation, and then settle back easily when the pressure is removed.

2. To check the valve for drip-tight closure, a line should be connected from the inlet to the cover, and pressure applied at the inlet of the valve. If properly assembled, the valve should hold tight with as low as ten PSI at the inlet. See "Tight Sealing Check" section.)

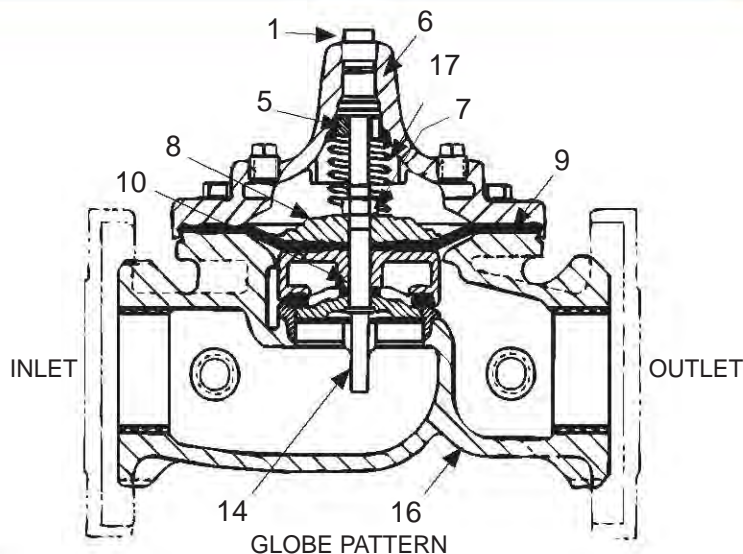
3. With the line connected from the inlet to the cover, apply full working pressure to the inlet. Check all around the cover for any leaks. Re-tighten cover nuts if necessary to stop leaks past the diaphragm.

4. Remove pressure, then re-install the pilot system and tubing exactly as it was prior to removal. **Bleed air from all high points.**

5. Follow steps under "Start-Up and Adjustment" Section in Technical Manual for returning complete valve back to service.

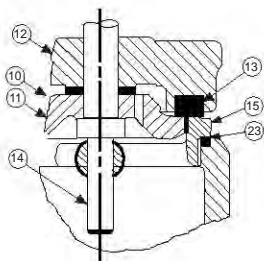
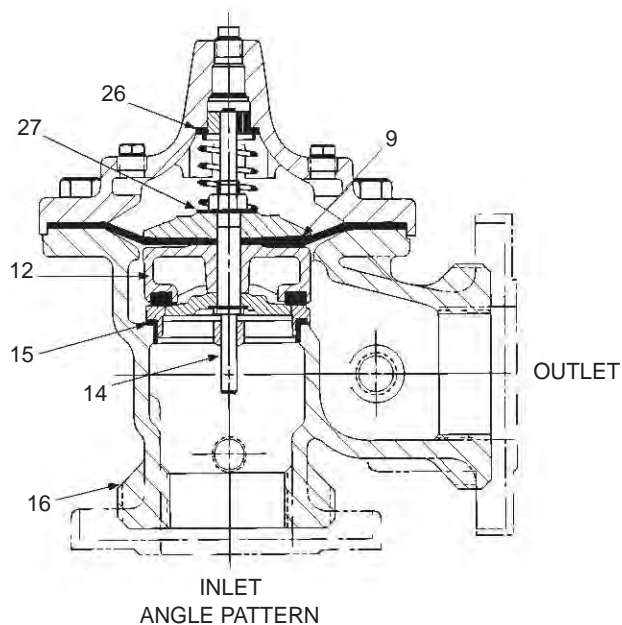


TOP VIEW

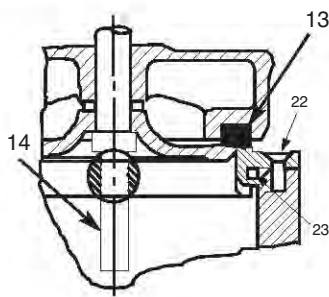


PARTS LIST

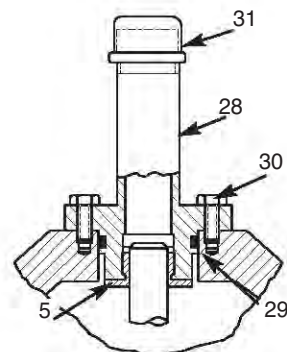
Item	Description
1.	Pipe Plug
2.	Drive Screws (for nameplate)
3.	Hex Nut (8" and larger)
4.	Stud (8" and larger)
5.	Cover Bearing
6.	Cover
7.	Stem Nut
8.	Diaphragm Washer
9.	Diaphragm
10.	Spacer Washers
11.	Disc Guide
12.	Disc Retainer
13.	Disc
14.	Stem
15.	Seat
16.	Body
17.	Spring
22.	Flat Head Screws (8" and larger)
23.	Seat O-Ring
24.	Hex head Bolt (1 1/4" thru 4")
25.	Nameplate
26.	Upper Spring Washer (Epoxy coated valves only)
27.	Lower Spring Washer (Epoxy coated valves only)
28.	Cover Bearing Housing (16" only)
29.	Cover O-Ring (16" only)
30.	Hex Bolt (16" only)
31.	Pipe Cap (16" only)



1 1/4" - 6" SEAT DETAIL



8" - 24" SEAT DETAIL



16" COVER DETAIL



— MODEL —

100-01 Hytrol Valve Service Data

Description 100-01 Hytrol Valve

The Cla-Val Model 100-01 Hytrol Valve is a main valve for Cla-Val Automatic Control Valves. It is a hydraulically operated, diaphragm-actuated, globe or angle pattern valve.

This valve consists of three major components; body, diaphragm assembly, and cover. The diaphragm assembly is the only moving part. The diaphragm assembly uses a diaphragm of nylon fabric bonded with synthetic rubber. A synthetic rubber disc, contained on three and one half sides by a disc retainer and disc guide, forms a seal with the valve seat when pressure is applied above the diaphragm. The diaphragm assembly forms a sealed chamber in the upper portion of the valve, separating operating pressure from line pressure.



Description 100-20 600 Series Hytrol Valve

The Cla-Val Model 100-20 Hytrol Valve (600 Series main valve) have only one part -the body- that is different from standard 100 Series Cla-Val main valve parts. The remaining parts of the 600 series main valve are standard Cla-Val main valve parts. All service and maintenance information for the standard 100 Series main valves also apply to the 600 series main valves.

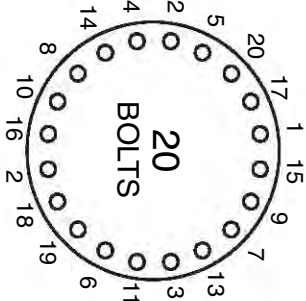
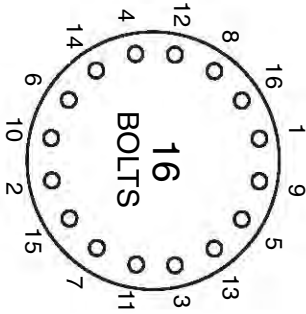
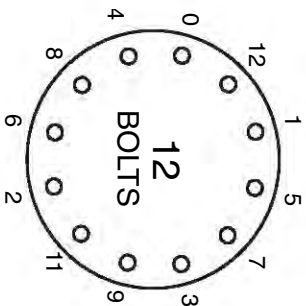
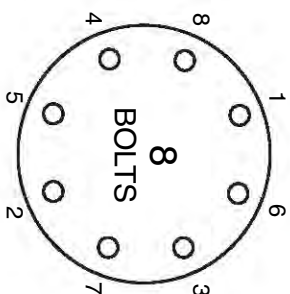
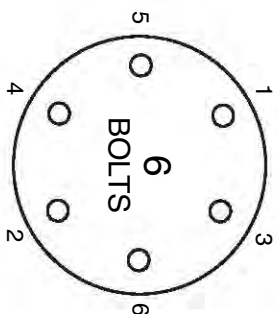
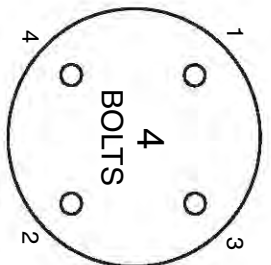
The most important thing to remember when ordering main valve repair kits and replacement parts, except for the body, all other parts are going to be for a smaller size main valve. Cla-Val identifies main valve parts with the flange size of the standard 100 Series main valve. Refer to the "Main Valve Sizes" chart below.

HYTROL Service Data

HYTROL SIZE				Stem Travel		Cover Capacity Displacement		Valve Stem Thread	Center Plug	Cover Nut or Bolt			Cover Lifting Holes		Cover Plug		Cover Torque		Stem Nut**		Stem Nut Torque	
100-01				100-20				UNF-Internal	NPT	Thread (Bolt)	Socket	Qty	UNC		Thread	Socket	ft. Lbs.	in. Lbs.	Thread	Socket (Long)	Lubed	DRY
inches	mm	inches	mm	inches	mm	Gallons	Liters															
1"	25			0.3	8				1/4"	1/4" - 20 (B)	7/16"	8					4	48	3/8" - 24		4	6
1 1/4"	32			0.4	10	0.020	0.07	10 - 32	1/4"	5/16" - 18 (B)	1/2"	8					8	96	7/16" - 20		6	10
1 1/2"	40			0.4	10	0.020	0.07	10 - 32	1/4"	5/16" - 18 (B)	1/2"	8					8	96	7/16" - 20		6	10
2"	50			0.6	15	0.032	0.12	10 - 32	1/2"	3/8" - 16 (B)	9/16"	8			3/8"	7/16"	12		1/2" - 20	3/4"	10	15
2 1/2"	65			0.7	18	0.043	0.16	10 - 32	1/2"	7/16" - 14 (B)	5/8"	8			1/2"	9/16"	20		5/8" - 18	15/16"	21	30
3"	80	4"	100	0.8	20	0.080	0.30	1/4 - 28	1/2"	1/2" - 13 (B)	3/4"	8			1/2"	9/16"	30		5/8" - 18	15/16"	21	30
4"	100	6"	150	1.1	23	0.169	0.64	1/4 - 28	3/4"	3/4" - 10 (B)	1 1/8"	8			3/4"	5/8"	110		3/4" - 16	1 1/16"	40	60
6"	150	8"	200	1.7	43	0.531	2.00	3/8 - 24	3/4"	3/4" - 10 (B)	1 1/8"	12			3/4"	5/8"	110		7/8" - 14	1 5/16"	85	125
8"	200	10"	250	2.3	58	1.26	4.80	3/8 - 24	1"	3/4" - 10	1 1/4"	16			1"	13/16"	110		1 1/8" - 12	1 13/16"	125	185
10"	250	12"	300	2.8	71	2.51	9.50	3/8 - 24	1"	7/8" - 9	1 7/16"	20			1"	13/16"	160		1 1/2" - 12	1 7/8"	252	375
12"	300	16"	400	3.4	86	4.0	15.10	3/8 - 24	1 1/4"	1 1/8" - 7	1 13/16"	20			1"	13/16"	390		1 1/2" - 12	2 1/2"	270	400
14"	350			3.9	99	6.5	24.60	3/8 - 24	1 1/2"	1 1/4" - 7	2"	20			1"	13/16"	545		1 1/2" - 12	2 1/2"	280	420
16"	400	20", 24"	600	4.5	114	9.6	36.20	1/2 - 20	2"	1 1/4" - 7	2"	20			1"	13/16"	545		2" - 16	3"	500	750
20"	500			5.63	143	12	45.40	3/4 - 16	1 1/2"	1 3/8" - 6	2 1/8"	24			1"	13/16"	670		2 1/4" - 16	3 1/2"	930	N/R
24"	600	30"	800	6.75	165	29.0	108.80	3/4 - 16*	3/4"	1 1/2" - 12	2 3/8"	24			1"	13/16"	800		3" - 12	Special	1350	N/R
* Adapter p/n 2594101E inside 1/4" - 28"										Grade 5 Bolts "Heavy" Grade Nuts Tighten cover nuts in a "star" cross-over pattern										** Must Use ONLY Cla-Val Supplied part		

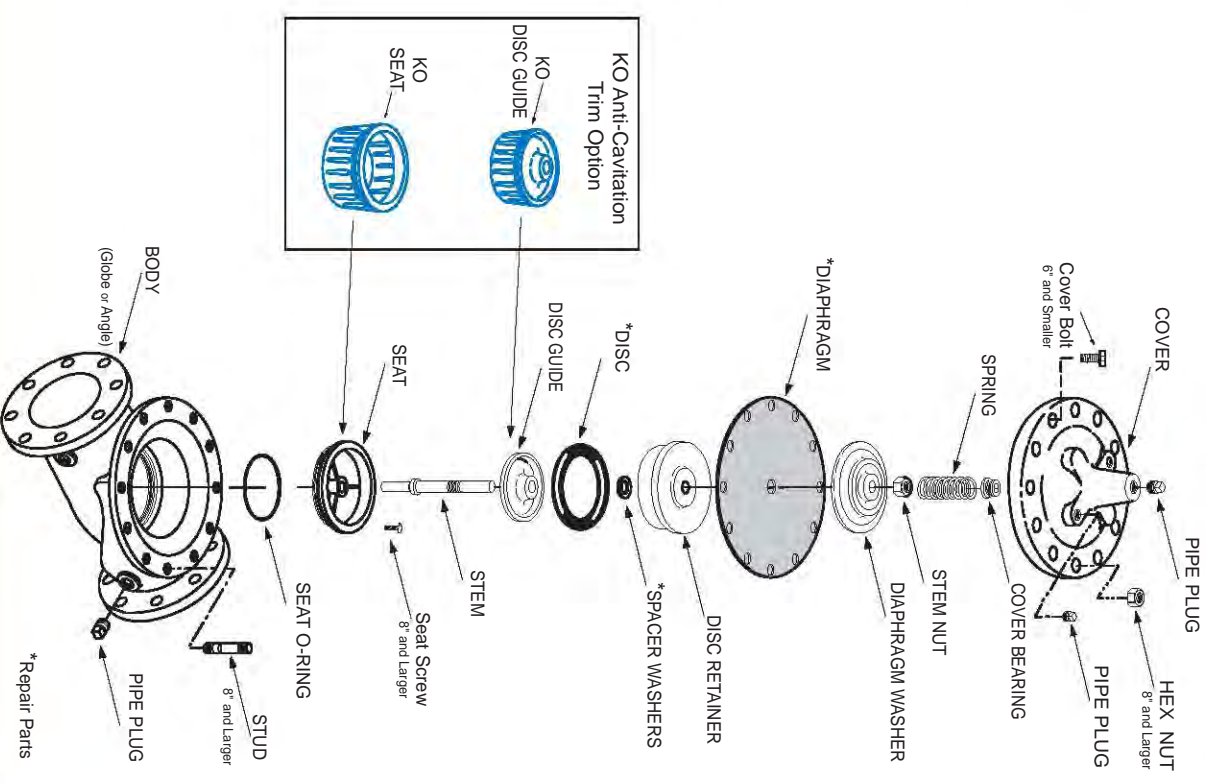
BOLT/NUT TORQUING PROCEDURES ON VALVE COVERS

100-01 Hytrol Main Valve Assembly



Follow this procedure when reassembling MAIN Valve:

1. Tightens bolts/nuts in a "Star" or "Cross-Over" pattern following the numbers shown above to insure that cover seats evenly on the diaphragm material and body.
2. Torque the bolt/nuts in three stages with a "Star" or "Cross-Over" pattern for each stage:
 - A. To approximately 10% of final torque.
 - B. To approximately 75% of final torque.
 - C. To final required torque.
3. Valves that are to be tested to 375 PSI or higher should be retorqued after 24 hours.





— MODEL — **100-20**
(Reduced Internal Port)

600 Series Hytrol Valve

SERVICE AND MAINTENANCE OF 600 SERIES VALVES

The 600 series main valves have only one part -the body- that is different from standard 100 Series Cla-Val main valve parts. The remaining parts of the 600 series main valve are standard Cla-Val main valve parts. All service and maintenance information for the standard 100 Series main valves in this manual also apply to the 600 series main valves.

The most important thing to remember when ordering main valve repair kits and replacement parts, except for the body, all other parts are going to be for a smaller size main valve. Cla-Val identifies main valve parts with the flange size of the standard 100 Series main valve. Refer to the "Main Valve Sizes Comparison" chart. For example, if you are servicing a 6" 100-20 Hytrol and needed a repair kit, you would order a repair kit for a 4" 100-01 Hytrol. This kit is also suitable for a 6" 100-20 Hytrol. Complete Technical Manuals include a repair kit data sheet N-RK that shows this relationship.

When you order repair parts, it is a good idea to include valve nameplate data (size, catalog number, and part number) and description of the parts desired. Do this to be sure parts will fit the valve you are working on and not be too big for it. Pilot controls and repair kits maintenance information remain the same for 100 or 600 Series valves.

UNDERSTANDING THE 600 SERIES VALVES

In 1987, Cla-Val introduced the Model 100-20 Hytrol as the basic main valve for the 600 Series of automatic control valves. To identify all new valves using the 100-20 Hytrol, an existing catalog number is modified. Making a 600 Series catalog number is simply done by using a "6" in front of the two digit catalog numbers or replacing the "2" with a "6" in three digit catalog numbers. Current schematics reflect both catalog numbers together separated by a slash (i.e. - 90-01/690-01, 58-02/658-02, 210-01/610-01, etc). Since these two valves 'share' the same catalog number and schematic, they provide the same function in a system. The only difference between the two valves is the relative capacity of the two main valve series.

The 100-01 Hytrol is the basic main valve for Cla-Val automatic control valves. This valve is the current version of the Clayton Hytrol valve design originated in 1936. The 100-01 Hytrol is designed as a full flow area valve. This means that the inlet, seat and outlet openings are the same size. Thus, the pressure drop is kept to a minimum for this globe style design.

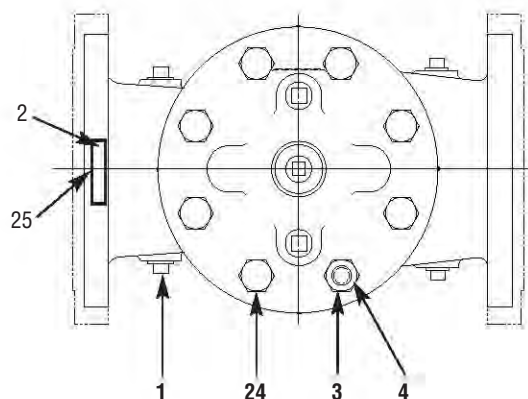
The 100-20 Hytrol valve has all of the basic features and advantages of the original 100-01 Hytrol. Only one part has been changed - the body. It is designed with different size inlet, seat and outlet openings. The 100-20 Hytrol has inlet and outlet flanges one valve size larger than the seat opening size. This results in what is sometimes called a 'reduced port' main valve. For example, a 4" 100-20 valve has a 3" seat. Note: valve size is always determined by the flange size. The following chart compares the 100-01 and the 100-20 main valves.

Basic Main Valve Size Comparison		
Globe Pattern Valves		
Flange Size (inch)	Seat Size	
	100-01 (100 Series)	100-20 (600 Series)
3	3	2
4	4	3
6	6	4
8	8	6
10	10	8
12	12	10
14	14	----
16	16	12
18	----	16
20	20	16
24	24	16
30	30	24
36	36	30
42	----	36
48	----	36
Angle Pattern Valves		
Flange Size (inch)	Seat Size	
	100-01 (100 Series)	100-20 (600 Series)
4	4	3
6	6	4
8	8	6

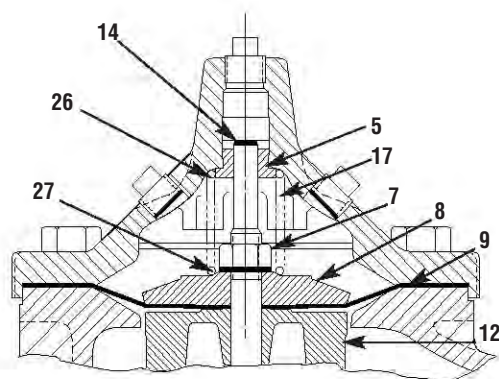
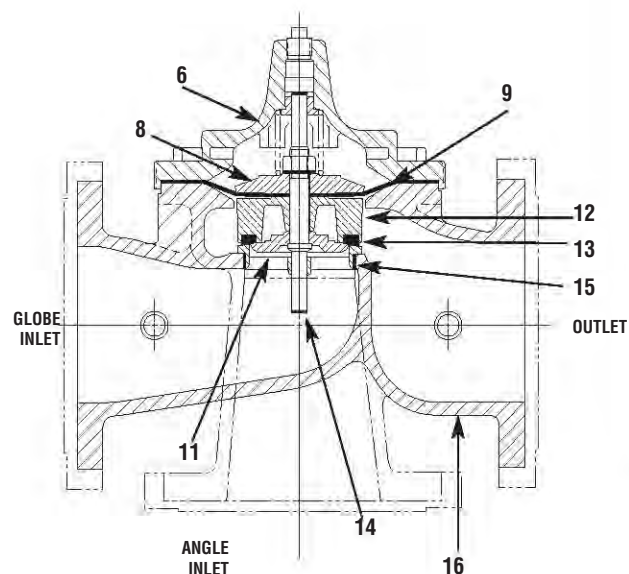
The 100-20 Hytrol is available only in ductile iron, 150 and 300 pressure class, and Bronze trim standard. Available extra cost main valve options include stainless steel trim, epoxy coating, Dura-Kleen stem, Delrin sleeved stem, and high temperature rubber parts. All four basic main valves have a 600 Series version available with all of the same benefits and size relationships. The following chart shows the relationship of Cla-Val main valve catalog numbers.

Cla-Val Main Valves

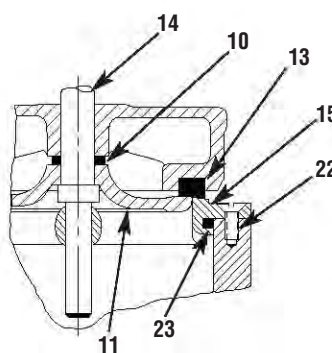
Catalog Name	Catalog Number		
	Circa 1936	100-Series	600 Series
Hytrol	100 (Angle =2100)	100-01	100-20
Powertrol	100P & 100PA	100-02	100-21
Powercheck	100PC & 100PCA	100-03	100-22
Hycheck	181	100-04	100-23



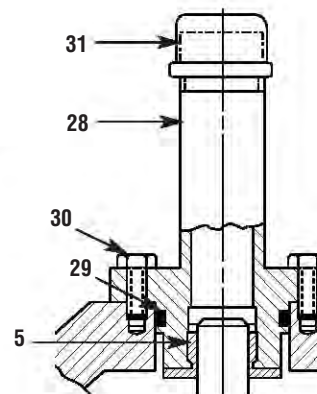
TOP VIEW



3" — 6" COVER DETAIL



10" — 24" SEAT DETAIL



20" — 24" COVER DETAIL

PARTS LIST

NO. DESCRIPTION

- | | |
|----|--|
| 1 | Pipe Plug |
| 2 | Drive Screws (for nameplate) |
| 3 | Hex Nut (8" and larger) |
| 4 | Stud (8" and larger) |
| 5 | Cover Bearing |
| 6 | Cover |
| 7 | Stem Nut |
| 8 | Diaphragm Washer |
| 9 | Diaphragm |
| 10 | Spacer Washers |
| 11 | Disc Guide |
| 12 | Disc Retainer |
| 13 | Disc |
| 14 | Stem |
| 15 | Seat |
| 16 | Body |
| 17 | Spring |
| 22 | Flat Head Screws (10" and larger) |
| 23 | Seat O-Ring |
| 24 | Hex Bolt (3 " Thru 6") |
| 25 | Nameplate (Mounted on inlet flange) |
| 26 | Upper Spring Washer (Epoxy coated valves only) |
| 27 | Lower Spring Washer (Epoxy coated valves only) |
| 28 | Cover Bearing Housing (20" & 24" & 30") |
| 29 | Cover Bearing Housing O-Ring (20" & 24" & 30") |
| 30 | Hex Bolt (20" & 24") |
| 31 | Pipe Cap (20" & 24" & 30") |

WHEN ORDERING PARTS, BE SURE TO GIVE COMPLETE NAMEPLATE DATA, ITEM NUMBER AND DESCRIPTION.

CLA-VAL CO.

NEWPORT BEACH, CALIFORNIA

CATALOG NO.

X58C

DRAWING NO.

48834

REV

AP

TYPE OF VALVE AND MAIN FEATURES

X58C RESTRICTION ASSEMBLIES

DESIGN

DRAWN

JC

12-3-85

CHK'D

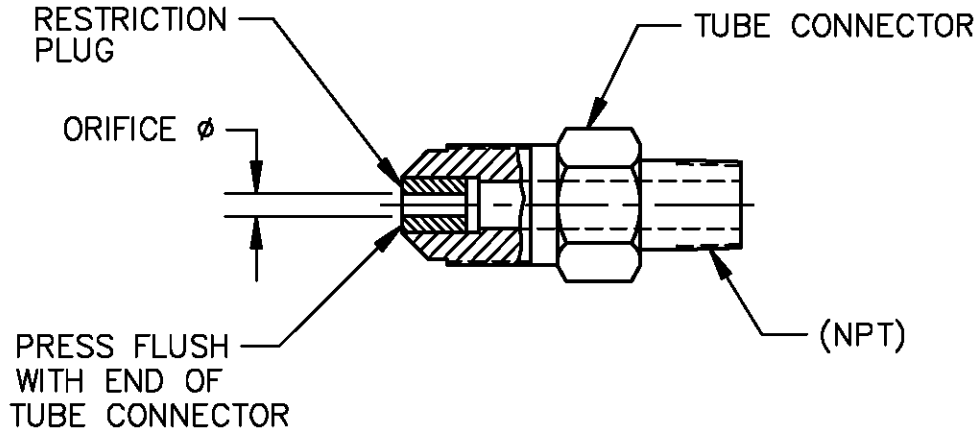
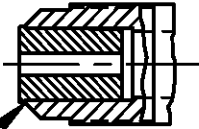
JC

12-4-85

APVD

CH

12-11-85

*79730J
PRESS TO
SHOULDER

NOTES:

1. *FOR IDENTIFICATION, THESE STOCK NO'S ARE TO BE STAINED BLUE WITH 74234-03.
2. **FOR IDENTIFICATION, THESE STOCK NO'S ARE TO BE STAINED RED WITH 74234-05.
3. SEE DWG 76740 FOR STAINLESS STEEL X58C.
4. SEE SHEETS 3 & 4 FOR UL APPROVED DRAWING.

CAD REVISION RECORD - DO NOT REVISE MANUALLY

DATE	BY	DESCRIPTION
11-18-93	EK	SEE REVISION FILE
		REDRAWN ON CAD (ECO 14229)



NEWPORT BEACH, CALIFORNIA

CATALOG NO.
X58CDRAWING NO.
48834REV
AP

TYPE OF VALVE AND MAIN FEATURES

X58C RESTRICTION ASSEMBLIES

DESIGN

DRAWN JC

12-3-85

CHK'D JC

12-4-85

APVD CH

12-11-85

X58C STOCK NO.	TUBE CONNECTOR		RESTRICTION PLUG	
	SIZE TUBE X NPT	MATERIAL	ORIFICE DIA	MATERIAL
<u>37° FLARE</u>				
**44734C	3/8 X 3/8-18 NPT	ALUMINUM	.125 (1/8)	S. STEEL
<u>45° FLARE</u>				
*37814B	1/4 X 1/8-27 NPT	BRASS	.031 (1/32)	S. STEEL
*80500C	1/4 X 1/8-27 NPT	BRASS	.062 (1/16)	S. STEEL
*67739D	3/8 X 1/8-27 NPT	BRASS	.040	S. STEEL
*64672K	3/8 X 3/8-18 NPT	BRASS	.062 (1/16)	S. STEEL
*99329-01D	3/8 X 3/8-18 NPT	BRASS	.094 (3/32)	S. STEEL
**79730J	1/2 X 1/2-14 NPT	BRASS	.125 (1/8)	S. STEEL
**48834-05F	3/8 X 3/8-18 NPT	BRASS	.125 (1/8)	S. STEEL
*85484E	1/4 X 1/8-27 NPT	BRASS	.031 (1/32)	DELRIN
*85486K	1/4 X 1/8-27 NPT	BRASS	.040	DELRIN
**48834-03A	1/4 X 1/8-27 NPT	BRASS	.125 (1/8)	DELRIN
*48834-04J	1/4 X 1/8-27 NPT	BRASS	.093	DELRIN
*88409-01G	3/8 X 1/8-27 NPT	BRASS	.031 (1/32)	DELRIN
*88409J	3/8 X 1/8-27 NPT	BRASS	.052	DELRIN
*42346H	3/8 X 1/8-27 NPT	BRASS	.062 (1/16)	DELRIN
**48834-01E	3/8 X 1/8-27 NPT	BRASS	.125 (1/8)	DELRIN
*42775H	3/8 X 1/4-18 NPT	BRASS	.062 (1/16)	DELRIN
**63604D	3/8 X 1/4-18 NPT	BRASS	.156 (5/32)	DELRIN
*10253D	3/8 X 3/8-18 NPT	BRASS	.031 (1/32)	DELRIN
*46946A	3/8 X 3/8-18 NPT	BRASS	.062 (1/16)	DELRIN
**64673H	3/8 X 3/8-18 NPT	BRASS	.125 (1/8)	DELRIN
*68565B	3/8 X 3/8-18 NPT	BRASS	.094 (3/32)	DELRIN
**43302K	3/8 X 3/8-18 NPT	BRASS	.188 (3/16)	DELRIN
**12900H	1/2 X 1/2-14 NPT	BRASS	.125 (1/8)	DELRIN
**48834-02C	1/2 X 1/2-14 NPT	BRASS	.188 (3/16)	DELRIN
**48834-06D	1/2 X 1/2-14 NPT	BRASS	.250 (1/4)	DELRIN

CAD REVISION RECORD - DO NOT REVISE MANUALLY

DATE

BY

DESCRIPTION

SEE SHEET 1

LIR

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— MODEL — **CRD**

Pressure Reducing Control



DESCRIPTION

The Cla-Val Model CRD Pressure Reducing Control automatically reduces a higher inlet pressure to a lower outlet pressure. It is a direct acting, spring loaded, diaphragm type control that operates hydraulically or pneumatically. It may be used as a self-contained valve or as a pilot control for a Cla-Val main valve. It will hold a constant downstream pressure within very close pressure limits.

OPERATION

The CRD Pressure Reducing Control is normally held open by the force of the compression spring above the diaphragm; and delivery pressure acts on the underside of the diaphragm. Flow through the valve responds to changes in downstream demand to maintain a pressure.

INSTALLATION

The CRD Pressure Reducing Control may be installed in any position. There is one inlet port and two outlets, for either straight or angle installation. The second outlet port can be used for a gage connection. A flow arrow is marked on the body casting.

ADJUSTMENT PROCEDURE

The CRD Pressure Reducing Control can be adjusted to provide a delivery pressure range as specified on the nameplate.

Pressure adjustment is made by turning the adjustment screw to vary the spring pressure on the diaphragm. The greater the compression on the spring the higher the pressure setting.

1. Turn the adjustment screw in (clockwise) to increase delivery pressure.
2. Turn the adjustment screw out (counter-clockwise) to decrease the delivery pressure.
3. When pressure adjustment is completed tighten jam nut on adjusting screw and replace protective cap.
4. When this control is used, as a pilot control on a Cla-Val main valve, the adjustment should be made under flowing conditions. The flow rate is not critical, but generally should be somewhat lower than normal in order to provide an inlet pressure several psi higher than the desired setting

The approximate minimum flow rates given in the table are for the main valve on which the CRD is installed.

Valve Size	1 1/4" -3"	4"-8"	10"-16"
Minimum Flow GPM	15-30	50-200	300-650

SYMPTOM	PROBABLE CAUSE	REMEDY
Fails to open when delivery pressure lowers	No spring compression	Tighten adjusting screw
	Damaged spring	Disassemble and replace
	Spring guide (8) is not in place	Assemble properly
	Yoke dragging on inlet nozzle	Disassemble and reassemble properly (refer to Reassembly)
Fails to close when delivery pressure rises	Spring compressed solid	Back off adjusting screw
	Mechanical obstruction	Disassemble and reassemble properly (refer to Reassembly)
	Worn disc	Disassemble remove and replace disc retainer assembly
	Yoke dragging on inlet nozzle	Disassemble and reassemble properly (refer to Reassembly)
Leakage from cover vent hole	Damaged diaphragm	Disassemble and replace
	Loose diaphragm nut	Remove cover and tighten nut

MAINTENANCE

Disassembly

To disassemble follow the sequence of the item numbers assigned to parts in the sectional illustration.

Reassembly

Reassembly is the reverse of disassembly. Caution must be taken to avoid having the yoke (17) drag on the inlet nozzle of the body (18).

Follow this procedure:

1. Place yoke (17) in body and screw the disc retainer assembly (16) until it bottoms.
2. Install gasket (14) and spring (19) for 2-30 and 2-6.5 psi range onto plug (13) and fasten into body. Disc retainer must enter guide hole in plug as it is assembled. Screw the plug in by hand. Use wrench to tighten only.
3. Place diaphragm (12) diaphragm washer (11) and Belleville washer (20) on yoke. Screw on hex nut (10).
4. Hold the diaphragm so that the screw holes in the diaphragm and body align. Tighten diaphragm nut with a wrench. At the final tightening release the diaphragm and permit it to rotate 5° to 10°. The diaphragm holes should now be properly aligned with the body holes.

To check for proper alignment proceed as follows:

Rotate diaphragm clockwise and counterclockwise as far as possible. Diaphragm screw holes should rotate equal distance on either side of body screw holes $\pm 1/8"$.

Repeat assembly procedure until diaphragm and yoke are properly aligned. There must be no contact between yoke and body nozzle during its normal movement. To simulate this movement hold body and diaphragm holes aligned. Move yoke to open and closed positions. There must be no evidence of contact or dragging.

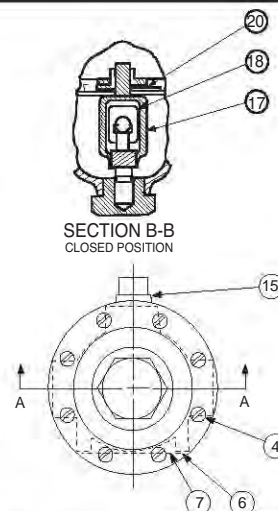
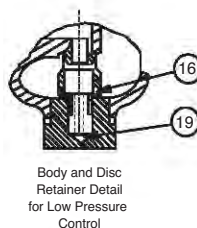
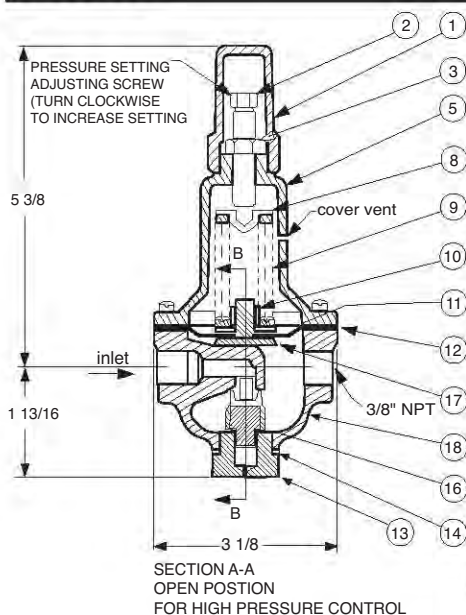
5. Install spring (9) with spring guide (8).
6. Install cover (5), adjusting screw (2) and nut (3), then cap (1).



CRD

Pressure Reducing Control

(Bronze Body with 303SS Trim)



Size (inch)	Stock Number	Adjustment Range	
		psi	Ft of Water
3/8	7194307A	2 - 6.5	4.5 - 15
3/8	7194308J	2 - 30	4.5 - 69
3/8	7194303K	15 - 75	35 - 173
3/8	7194311C	20 - 105	46 - 242
3/8	7194304H	30 - 300	69 - 692
Factory Set Pressure		PSI per Turn*	
	2 - 6.5 set @ 3.5 psi	.61	
	2 - 30 set @ 10 psi	3.0	
	15 - 75 set @ 20 psi	9.0	
	20 - 105 set @ 60 psi	12.0	
	30 - 300 set @ 60 psi	27.0	

*Approximate-Final Adjustment should be with a pressure gauge and with flow.

When ordering parts specify:

- All nameplate data
- Item Description
- Item number

Item	Description	Material	Part Number	List Price
1	Cap	PL	67628J	
2	Adjusting Screw	BRS	7188201D	
3	Jam Nut (3/8-16)	SS	6780106J	
4*	Machine Screw (Fil.Hd.) 8 Req'd	303	6757821B	
5	Cover	BRS	C2544K	
6	Nameplate Screw	SS	67999D	
7	Nameplate	BRS	C0022001G	
8	Spring Guide	302	71881H	
	Spring Guide (20 - 105 psi)	303	205620F	
9	Spring (15-75 psi)	CHR/VAN	71884B	
	Spring (2 - 6.5 psi)	SS	82575C	
	Spring (2 - 30 psi)	SS	81594E	
	Spring (20 - 105 psi)	316	20632101E	
	Spring (30 - 300 psi)	CHR/VAN	71885J	
10	Hex Nut	303	71883D	
11	Diaphragm Washer	302	71891G	
12*	Diaphragm	NBR	C6936D	
13	Plug, Body	BRS	V5653A	
14*	Gasket	Fiber	40174F	
15	Plug	BRS	6766003F	
16*	Disc Retainer Assy. (2 - 30 psi)	SS/Rub	C8348K	
	Disc Retainer Assy. (15 - 75 psi)	SS/Rub	37133G	
	Disc Retainer Assy. (20 - 105 psi)	SS/Rub	37133G	
	Disc Retainer Assy. (30 - 300 psi)	SS/Rub	37133G	
17	Yoke	VBZ	V6951H	
18	Body & 1/4" Seat Assy	BR/SS	8339702G	
19*	Bucking Spring (2 - 6.5 psi)(2 - 30psi)	302	V0558G	
20	Belleville Washer	STL	7055007E	
*	Repair Kit (No Bucking Spring)	Buna®-N	9170003K	
*	Repair Kit (with Bucking Spring)	Buna®-N	9170002B	

*SUGGESTED REPAIR PARTS



— MODEL — **CRL**

Pressure Relief Control

DESCRIPTION

The CRL Pressure Relief Control is a direct acting, spring loaded, diaphragm type relief valve. It may be used as a self-contained valve or as a pilot control for a Cla-Val Main valve. It opens and closes within very close pressure limits.

INSTALLATION

The CRL Pressure Relief Control may be installed in any position. The control body (7) has one inlet and one outlet port with a side pipe plug (24) at each port. These plugs are used for control connections or gauge applications. The inlet in the power unit body (6) is the sensing line port. A flow arrow is marked on the body casting.

OPERATION

The CRL Pressure Relief Control is normally held closed by the force of the compression spring above the diaphragm; control pressure is applied under the diaphragm.

When the controlling pressure exceeds the spring setting, the disc is lifted off its seat, permitting flow through the control.

When controlling pressure drops below spring setting, the spring returns the control to its normally closed position.

ADJUSTMENT PROCEDURE

The CRL Pressure Relief Control can be adjusted to provide a relief setting at any point within the range found on the nameplate.

Pressure adjustment is made by turning the adjustment screw (9) to vary the spring pressure on the diaphragm. Turning the adjustment screw clockwise increases the pressure required to open the valve. Counterclockwise decreases the pressure required to open the valve.

When pressure adjustments are complete the jam nut (10) should be tightened and the protective cap (1) replaced. If there is a problem of tampering, lock wire holes have been provided in cap and cover. Wire the cap to cover and secure with lead seal.

DISASSEMBLY

The CRL Pressure Relief Control does not need to be removed from the line for disassembly. Make sure that pressure shut down is accompanied prior to disassembly. If the CRL is removed from the line for disassembly be sure to use a soft jawed vise to hold body during work.

Refer to Parts List Drawing for Item Numbers.

1. Remove cap (1), loosen jam nut (10) and turn adjusting screw counterclockwise until spring tension is relieved.
2. Remove the eight screws (4) holding the cover (3) and powerunit body (6). Hold the cover and powerunit together and place on a suitable work surface.
See NOTE under REASSEMBLY.
3. Remove the cover (3) from powerunit body (6). The spring (12) and two spring guides (11).
4. Remove nut (13) from stem (19) and slide off the belleville washer (14), the upper diaphragm washer (15) and the diaphragm (16).
5. Pull the stem (19) with the disc retainer assembly (21) through the bottom of powerunit. The lower diaphragm washer (17) will slide off of stem top.
6. Remove jam nut (23) and disc retainer assembly (21) from stem. Use soft jawed pliers or vise to hold stem. The polished surface of stem must not be scored or scratched.
7. The seat (22) need not be removed unless it is damaged. If removal is necessary use proper size socket wrench and turn counterclockwise.

Note: Some models have an integral seat in the body (7).

INSPECTION

Inspect all parts for damage, or evidence of cross threading. Check diaphragm and disc retainer assembly for tears, abrasions or other damage. Check all metal parts for damage, corrosion or excessive wear.

REPAIR AND REPLACEMENT

Minor nicks and scratches may be polished out using 400 grit wet or dry sandpaper fine emery or crocus cloth. Replace all O-rings and any damaged parts.

When ordering replacement parts, be sure to specify parts list item number and all nameplate data.

REASSEMBLY

In general, reassembly is the reverse of disassembly. However, the following steps should be observed:

1. Lubricate the O-Ring (18) with a small amount of a good grade of waterproof grease, (Dow Corning 44 medium grade or equal). Use grease sparingly and install O-ring in powerunit body (6).
2. Install stem (19) in powerunit body (6). Use a rotating motion with minimum pressure to let stem pass through O-ring.
Do Not Cut O-Ring.
3. Install O-ring (5) at top of stem (19). Place lower diaphragm washer (17) on the stem with the serrated side up. Position diaphragm (16), upper diaphragm washer (15), with serration down, and belleville washer (14) with concave side down.
4. Position powerunit body (6) as shown on parts list drawing (top view).
5. Continue reassembly as outlined in disassembly steps 1 through 3.

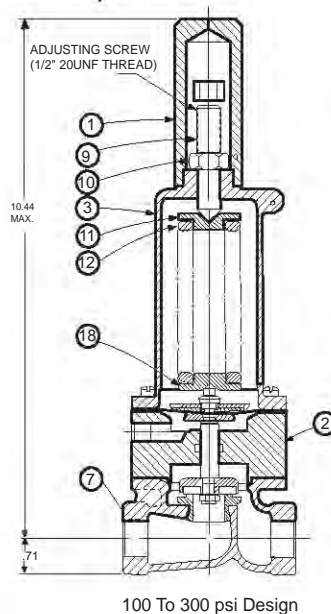
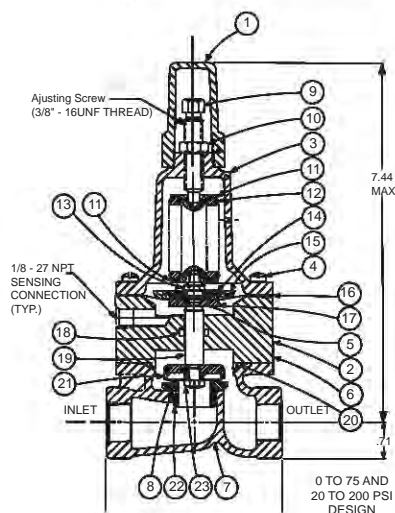
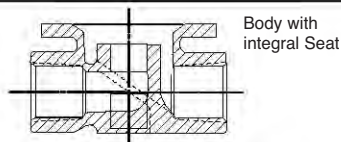
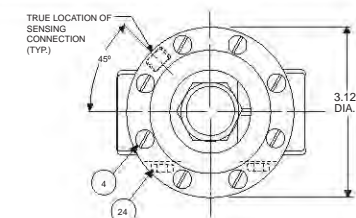
Note: Item (4) Screw will have a quantity of 8 for the 0-75 and 20-200psi design and a quantity of 4 for the 100-300psi design. Item (25) Screw is used on the 100-300psi design only. Install item (25), before item (4) for preload of item (12) spring.

SYMPTOM	PROBABLE CAUSE	REMEDY
Fails to open.	Controlling pressure too low.	Back off adjusting screw until valve opens.
Fails to open with spring compression removed.	Mechanical obstruction, corrosion, scale build-up on stem.	Disassemble, locate, and remove obstruction, scale.
Leakage from cover vent hole when controlling pressure is applied.	Diaphragm Damage	Disassembly replace damaged diaphragm.
	Loose diaphragm assembly.	Tighten upper diaphragm washer.
Fails to close.	No spring compression.	Re-set pressure adjustment.
Fails to close with spring compressed.	Mechanical obstruction.	Disassemble, locate and remove obstruction.



1/2" & 3/4" PRESSURE RELIEF CONTROL

(Bronze Body with 303SS Trim)



SIZE	SPRING	PART NUMBER
1/2"	0-75 PSI	7922201E
1/2"	20-105 PSI	7922205F
1/2"	20-200 PSI	7922202C
1/2"	100-300 PSI	8280901D
3/4"	0-75 PSI	7922901K
3/4"	20-105 PSI	7922903F
3/4"	20-200 PSI	7922902H
3/4"	100-300 PSI	8600501E
For 250-600 PSI Contact Factory		

CRL Range PSI	APPROX. INCREASE FOR EACH CLOCKWISE TURN OF ADJUSTING SCREW
0 to 75	8.5 PSI
20 to 105	12.5 PSI
20 to 200	28.0 PSI
100 to 300	18.0 PSI

When ordering parts please specify:

1. All Nameplate Data
2. Item Part Number
3. Item Description

Item	Description	Material	Part Number	Part Number	Part Number	Part Number
			0-75	20-105	20-200	100-300
1	Cap	Plastic	67628J	67628J	67628J	1257601D
2	Nameplate	Brass	--	--	--	--
3	Cover	Bronze	C2544K	C2544K	C2544K	44587E
4*	Screw Fil. Hd. 10-32 x 1.88 (Qty 8)	303 SS	6757867E	6757867E	6757867E	6757867E
5*	O-Ring	Rubber	00902H	00902H	00902H	00902H
6	Body, Powerunit	Bronze	7920504D	7920504D	7920504D	7920504D
7	1/2" Body	Bronze	C7928K	C7928K	C7928K	C7928K
8*	3/4" Body	Bronze	C9083B	C9083B	C9083B	C9083B
9	O-Ring, Seat	Rubber	00718H	00718H	00718H	00718H
10	Screw, Adjusting	Brass	7188201D	7188201D	7188201D	82811B
11	Nut Hex (Locking)	303 SS	6780106J	6780106J	6780106J	6780606H
12	Guide, Spring	303 SS	71881H	71881H	71881H	1630301J
13	Spring	CHR/VAN	71884B	20632101E	71885J	1630201A
14	Nut, Stem Upper	Bronze	73034B	73034B	73034B	73034B
15	Washer, Belleville	Steel	7055007E	7055007E	7055007E	7055007E
16*	Washer, Diaphragm (upper)	303 SS	71891G	71891G	71891G	71891G
17*	Diaphragm	Rubber	C1505B	C1505B	C1505B	C1505B
18*	Washer, Diaphragm (lower)	303 SS	45871B	45871B	45871B	45871B
19*	O-Ring, Stem	Rubber	00746J	00746J	00746J	00746J
20*	Stem	303 SS	8982401F	8982401F	8982401F	8982401F
21*	O-Ring, Body	Rubber	00767E	00767E	00767E	00767E
22*	Retainer Assembly, Disc	303 SS	C9158B	C9158B	C9158B	C9158B
23	Seat	303Rub	62187A	62187A	62187A	62187A
24	Nut, Hex, Stem, Lower	Bronze	6779806G	6779806G	6779806G	6779806G
	Pipe Plug	Bronze	6784701C	6784701C	6784701C	6784701C
FACTORY SET POINT			50 PSI	60 PSI	60 PSI	100 PSI
REPAIR KIT*			9170007A	9170007A	9170007A	9170007A



Regulator Spring Color Coding Chart

Dwg#47117

*THESE FIGURES ARE ONLY APPROXIMATE. FINAL ADJUSTMENTS SHOULD BE MADE WITH A PRESSURE GAGE.

WIRE SIZE	SPRING NUMBER	COLOR	WIRE MATERIAL	CATALOG NUMBER	PSI RANGE	*PSI PER TURN
.080 DIA.	C0492D	BLUE	S.S.	CDB-7 CRL-5A	0-7 0-7	.75 .75
.018 DIA.	82575C	--	S.S.	CRD CRD-10A	1.9-6.5 1.9-6.5	.61 .49
.116 DIA.	81594E	--	S.S.	CRD CRD-10A	2-30 2-30	3.0 2.4
.120 DIA.	V5654J	GREEN	CHR VAN	CRL-5A CRD	5-25 10-40	4.0 4.0
.162 DIA.	32447F	NATURAL	S.S.	CDB-7 CRL-5A CRL-13	10-60 10-60 10-60	12.0 12.0 12.0
.162 DIA.	V5695B	YELLOW	MUSIC WIRE	CDB-7 CRL-5A CRL-13	20-80 20-80 20-80	14.5 14.5 14.5
.207 DIA.	C1124B	CAD PLT	MUSIC WIRE	CDB-7 CRL-13 CRL-5A	50-150 50-150 50-150	29.5 29.5 29.5
.225 DIA.	V6515A	RED	MUSIC WIRE	CDB-7 CRL-13 CRL-5A	65-180 65-180 65-180	44.0 44.0 44.0
.115 X .218	71884B	RED	CHR VAN	CRL CRD CRD-10A	0-75 15-75 15-75	8.5 9.0 7.2
.118 X .225	71885J	GREEN	CHR VAN	CRL CRD CRD-10A	20-200 30-300 30-300	28.0 27.0 22.4
.225 X .295	1630201A	CAD PLT	CHR VAN	CRL CRL-5A	100-300 100-300	18.00 18.00
.440 X .219	48211H	CAD PLT	STEEL	CRA-18 CRD-22 CRL-4A	200-450 200-450 100-450	17.0 17.0 17.0
.187	20632101E	BLACK	316 SST	CRD CRL	20-105 20-105	13.0 13.0
WIRE SIZE	SPRING NUMBER	COLOR	WIRE MATERIAL	CATALOG NUMBER	FEET RANGE	*FEET PER TURN
.080 DIA.	C0492D	BLUE	S.S.	CRA CRD-2	4.5-15 4.5-15	.82 .82
.375 DIA.	87719B 1 SPRING 2 SPRING 3 SPRING 4 SPRING 5 SPRING	EPOXY COATED	CHROME SILICON	CDS-5	5-40 30-80 70-120 110-120 150-200	1.0 2.0 3.0 4.0 5.0
.072 DIA.	V5097A	--	302SS	CVC	1-17	.7
.375 DIA.	2933502H 1 SPRING 2 SPRING 3 SPRING 4 SPRING 5 SPRING	EPOXY COATED	CHROME SILICON	CDS-6A	5-40 30-80 70-120 110-160 150-200	.75 1.50 2.20 3.00 3.70

THE FOLLOWING CONTROL & SPRING P/N#S WERE REMOVED, 32656B, 31554K, 44591G, V65695B, & V5695B.
ADDED CRL-13, CRL-5A, CRA, CRA-10A, CHANGED SPRING RANGES TO MATCH CURRENT CONTROLS.

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— MODEL — **X46**

Flow Clean Strainer



X46A Straight

X46B Angle

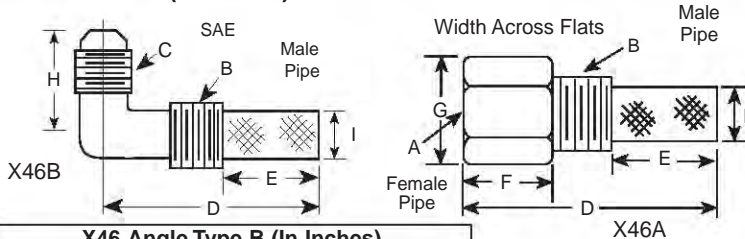


- Self Scrubbing Cleaning Action
- Straight Type or Angle Type

The Cla-Val Model X46 Strainer is designed to prevent passage of foreign particles larger than .015". It is especially effective against such contaminant as algae, mud, scale, wood pulp, moss, and root fibers. There is a model for every Cla-Val. valve.

The X46 Flow Clean strainer operates on a velocity principle utilizing the circular "air foil" section to make it self cleaning. Impingement of particles is on the "leading edge" only. The low pressure area on the downstream side of the screen prevents foreign particles from clogging the screen. There is also a scouring action, due to eddy currents, which keeps most of the screen area clean.

Dimensions (In Inches)



X46 Angle Type B (In Inches)

B(NPT)	C(SAE)	D	E	H	I
1/8	1/4	1-3/8	5/8	7/8	1/4
1/4	1/4	1-3/4	3/4	1	3/8
3/8	1/4	2	7/8	1	1/2
3/8	3/8	1-7/8	7/8	1	1/2
1/2	3/8	2-3/8	1	1-1/4	5/8

**When Ordering,
Please Specify:**

- Catalog Number X46
- Straight Type or Angle Type
- Size Inserted Into and Size Connection
- Materials

X46A Straight Type A (In Inches)

A (NPT)	B (NPT)	D	E	F	G	I
1/8	1/8	1-3/4	3/4	1/2	1/2	1/4
1/4	1/4	2-1/4	1	3/4	3/4	3/8
3/8	3/8	2-1/2	1	7/8	7/8	1/2
3/8	1/2	2-1/2	1-1/4	1/2	7/8	3/4
1/2	1/2	3	1-1/4	1	1-1/8	3/4
3/8	3/4	3-3/8	2	1/2	1	7/8
3/4	3/4	4	2	1	1-1/2	7/8
3/8	1	4-1/4	2-3/4	1/2	1-3/8	7/8
1	1	4-1/2	2-3/4	1-1/4	1-3/4	7/8
1/2	1	4-1/4	2-3/4	1/2	1-3/8	7/8

INSTALLATION

The strainer is designed for use in conjunction with a Cla-Val Main Valve, but can be installed in any piping system where there is a moving fluid stream to keep it clean. When it is used with the Cla-Val Valve, it is threaded into the upstream body port provided for it on the side of the valve. It projects through the side of the Main Valve into the flow stream. All liquid shunted to the pilot control system and to the cover chamber of the Main Valve passes through the X46 Flow Clean Strainer.

INSPECTION

Inspect internal and external threads for damage or evidence of cross-threading. Check inner and outer screens for clogging, embedded foreign particles, breaks, cracks, corrosion, fatigue, and other signs of damage.

DISASSEMBLY

Do not attempt to remove the screens from the strainer housing.

CLEANING

After inspection, cleaning of the X46 can begin. Water service usually will produce mineral or lime deposits on metal parts in contact with water. These deposits can be cleaned by dipping X46 in a 5-percent muriatic acid solution just long enough for deposit to dissolve. This will remove most of the common types of deposits.

Caution: use extreme care when handling acid. If the deposit is not removed by acid, then a fine grit (400) wet or dry sandpaper can be used with water. Rinse parts in water before handling. An appropriate solvent can clean parts used in fueling service. Dry with compressed air or a clean, lint-free cloth. Protect from damage and dust until reassembled.

REPLACEMENT

If there is any sign of damage, or if there is the slightest doubt that the Model X46 Flow Clean Strainer may not afford completely satisfactory operation, replace it. Use Inspection steps as a guide. Neither inner screen, outer screen, nor housing is furnished as a replacement part. Replace Model X46 Flow Clean Strainer as a complete unit.

When ordering replacement Flow-Clean Strainers, it is important to determine pipe size of the tapped hole into which the strainer will be inserted (refer to column A or F), and the size of the external connection (refer to column B or G).

07-10-08 AK 08-14-08 AK 10-1-2008 PC	CLA-VAL CO. NEWPORT BEACH, CALIFORNIA		CATALOG NO.		DRAWING NO. <div style="font-size: 1.2em;">67783</div>		REV <div style="font-size: 1.2em;">BD</div>																																																																																											
	TYPE OF VALVE AND MAIN FEATURES <div style="font-size: 1.5em; margin-top: 10px;">CK2 COCK/BALL VALVE</div>																																																																																																	
	SCALE: NONE																																																																																																	
CLA-VAL PART NO. AND MATERIAL																																																																																																		
<table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr> <th>BRONZE WITH HANDLE</th> <th>STEEL WITH HANDLE</th> <th>IRON WITH HANDLE</th> <th>316 SST WITH HANDLE</th> <th>316 SST W/ LOCKING HANDLE</th> <th>BRONZE WITH HANDLE</th> <th>MONEL WITH HANDLE</th> <th>MONEL W/ LOCKING HANDLE</th> <th>SIZE "NPT"</th> </tr> </thead> <tbody> <tr> <td>67783-01K*</td> <td>-09C</td> <td>-17F</td> <td>-25J SUPSD BY-26G</td> <td></td> <td>-41F SUPSD BY-01K</td> <td></td> <td></td> <td>1/8"</td> </tr> <tr> <td>-02H</td> <td>-10A</td> <td>-18D</td> <td>-26G</td> <td>-51E SUPSD BY-26G -52C</td> <td>-42D SUPSD BY-02H</td> <td>-55F</td> <td></td> <td>1/4"</td> </tr> <tr> <td>-03F* -59H***</td> <td>-11J</td> <td>-19B</td> <td>-27E</td> <td>-46E SUPSD BY-27E -53A</td> <td>-45G -57B**</td> <td>-48A SUPSD BY-49J</td> <td>-63K</td> <td>3/8"</td> </tr> <tr> <td>-04D -60F***</td> <td>-12G</td> <td>-20K</td> <td>-28C</td> <td>-54J</td> <td>-43B SUPSD BY-04D</td> <td>-49J</td> <td>-62B</td> <td>1/2"</td> </tr> <tr> <td>-05A -61D***</td> <td>-13E</td> <td>-21H</td> <td>-29A</td> <td>-64H</td> <td>-44K SUPSD BY-05A</td> <td>-56D</td> <td></td> <td>3/4"</td> </tr> <tr> <td>-06J</td> <td>-14C</td> <td>-22F</td> <td>-30J</td> <td></td> <td></td> <td>-58K</td> <td></td> <td>1"</td> </tr> <tr> <td>-07G</td> <td>-15K</td> <td>-23D</td> <td>-31G</td> <td></td> <td></td> <td></td> <td></td> <td>1 1/4"</td> </tr> <tr> <td>-08E</td> <td>-16H</td> <td>-24B</td> <td>-32E</td> <td></td> <td></td> <td></td> <td></td> <td>1 1/2"</td> </tr> <tr> <td>-50G</td> <td></td> <td></td> <td>-47C</td> <td></td> <td></td> <td></td> <td></td> <td>2"</td> </tr> </tbody> </table>									BRONZE WITH HANDLE	STEEL WITH HANDLE	IRON WITH HANDLE	316 SST WITH HANDLE	316 SST W/ LOCKING HANDLE	BRONZE WITH HANDLE	MONEL WITH HANDLE	MONEL W/ LOCKING HANDLE	SIZE "NPT"	67783-01K*	-09C	-17F	-25J SUPSD BY-26G		-41F SUPSD BY-01K			1/8"	-02H	-10A	-18D	-26G	-51E SUPSD BY-26G -52C	-42D SUPSD BY-02H	-55F		1/4"	-03F* -59H***	-11J	-19B	-27E	-46E SUPSD BY-27E -53A	-45G -57B**	-48A SUPSD BY-49J	-63K	3/8"	-04D -60F***	-12G	-20K	-28C	-54J	-43B SUPSD BY-04D	-49J	-62B	1/2"	-05A -61D***	-13E	-21H	-29A	-64H	-44K SUPSD BY-05A	-56D		3/4"	-06J	-14C	-22F	-30J			-58K		1"	-07G	-15K	-23D	-31G					1 1/4"	-08E	-16H	-24B	-32E					1 1/2"	-50G			-47C					2"
BRONZE WITH HANDLE	STEEL WITH HANDLE	IRON WITH HANDLE	316 SST WITH HANDLE	316 SST W/ LOCKING HANDLE	BRONZE WITH HANDLE	MONEL WITH HANDLE	MONEL W/ LOCKING HANDLE	SIZE "NPT"																																																																																										
67783-01K*	-09C	-17F	-25J SUPSD BY-26G		-41F SUPSD BY-01K			1/8"																																																																																										
-02H	-10A	-18D	-26G	-51E SUPSD BY-26G -52C	-42D SUPSD BY-02H	-55F		1/4"																																																																																										
-03F* -59H***	-11J	-19B	-27E	-46E SUPSD BY-27E -53A	-45G -57B**	-48A SUPSD BY-49J	-63K	3/8"																																																																																										
-04D -60F***	-12G	-20K	-28C	-54J	-43B SUPSD BY-04D	-49J	-62B	1/2"																																																																																										
-05A -61D***	-13E	-21H	-29A	-64H	-44K SUPSD BY-05A	-56D		3/4"																																																																																										
-06J	-14C	-22F	-30J			-58K		1"																																																																																										
-07G	-15K	-23D	-31G					1 1/4"																																																																																										
-08E	-16H	-24B	-32E					1 1/2"																																																																																										
-50G			-47C					2"																																																																																										
<p>* SEE ENGINEERING APPROVED VENDORS TABLE (SHEET 2 OF 2).</p> <p>** HAMMOND VALVE 8501 ONLY.</p> <p>*** WILKINS CK2 (SEE SHEET 2 OF 2)</p>																																																																																																		

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— MODEL — **CV**
Flow Control



DESCRIPTION

The Cla-Val Model CV Flow Control is a simply-designed, spring-loaded check valve. Rate of flow is full flow in one direction and restricted in other direction. Flow is adjustable in the restricted direction. It is intended for use in conjunction with a pilot control system on a Cla-Val Automatic Control Valve.

OPERATION

The CV Flow Control permits full flow from port A to B, and restricted flow in the reverse direction. Flow from port A to B lifts the disc from seat, permitting full flow. Flow in the reverse direction seats the disc, causing fluid to pass through the clearance between the stem and the disc. This clearance can be increased, thereby increasing the restricted flow, by screwing the stem out, or counter-clockwise. Turning the stem in, or clockwise reduces the clearance between the stem and the disc, thereby reducing the restricted flow.

INSTALLATION

Install the CV Flow Control as shown in the valve schematic. All connections must be tight to prevent leakage.

DISASSEMBLY

Follow the sequence of the item numbers assigned to the parts in the cross sectional illustration for recommended order of disassembly.

Use a scriber, or similar sharp-pointed tool to remove O-ring from the stem.

INSPECTION

Inspect all threads for damage or evidence of cross-threading. Check mating surface of seat and valve disc for excessive scoring or embedded foreign particles. Check spring for visible distortion, cracks and breaks. Inspect all parts for damage, corrosion and cleanliness.

CLEANING

After disassembly and inspection, cleaning of the parts can begin. Water service usually will produce mineral or lime deposits on metal parts in contact with water. These deposits can be cleaned by dipping the parts in a 5-percent muriatic acid solution just long enough for deposits to dissolve. This will remove most of the common types of deposits. **Caution: use extreme care when handling acid.** If the deposit is not removed by acid, then a fine grit (400) wet or dry sandpaper can be used with water. Rinse parts in water before handling. An appropriate solvent can clean parts used in fueling service. Dry with compressed air or a clean, lint-free cloth. Protect from damage and dust until reassembled.

REPAIR AND REPLACEMENT

Minor nicks and scratches may be polished out using a fine grade of emery or crocus cloth; replace parts if scratches cannot be removed.

Replace O-ring packing and gasket each time CV Flow Control is overhauled.

Replace all parts which are defective. Replace any parts which create the slightest doubt that they will not afford completely satisfactory operation. Use Inspection steps as a guide.

REASSEMBLY

Reassembly is the reverse of disassembly; no special tools are required.

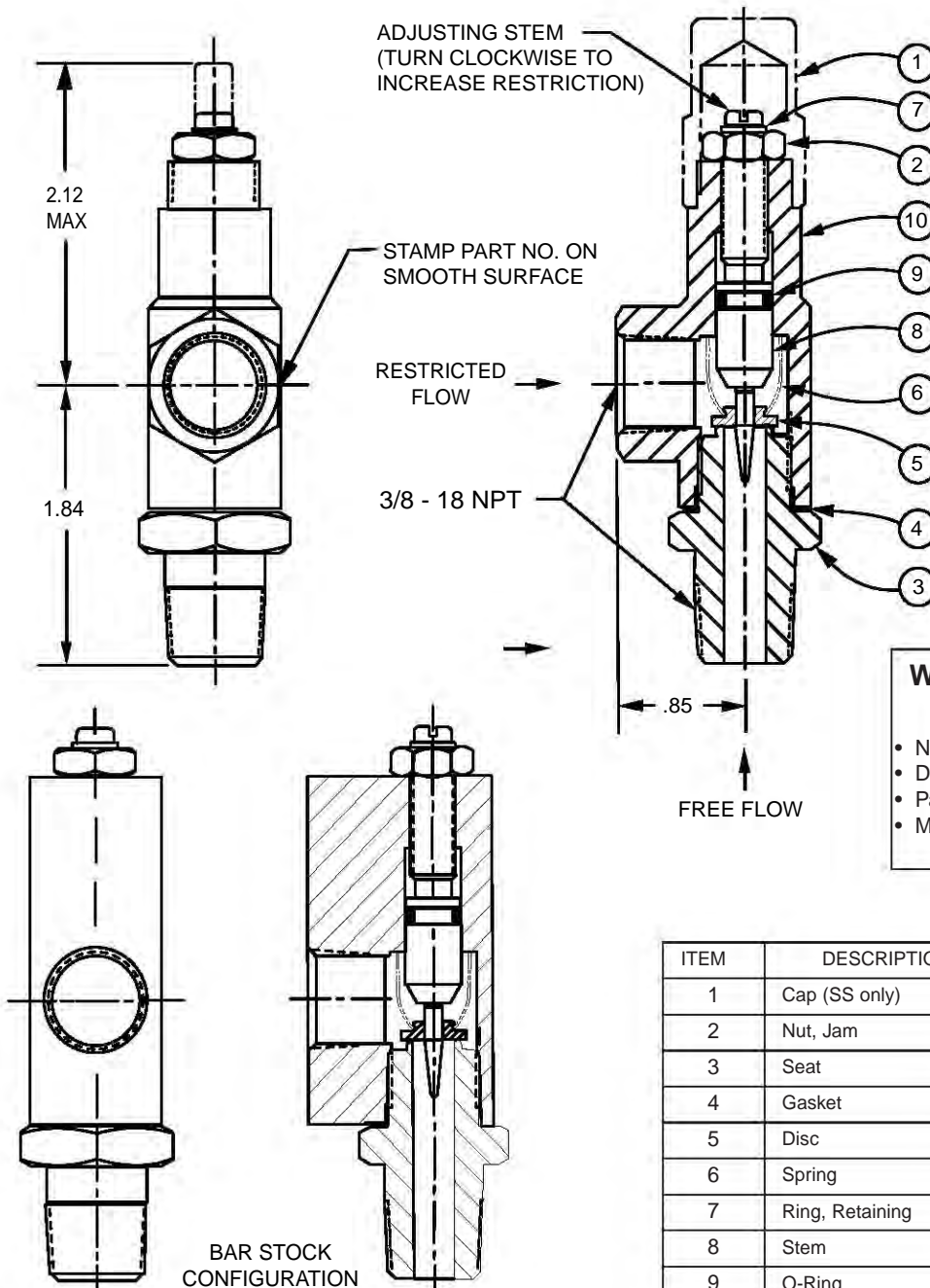
TEST PROCEDURE

No testing of the flow Control is required prior to reassembly to the pilot control system on Cla-Val Main Valve.



CV

3/8" Flow Control



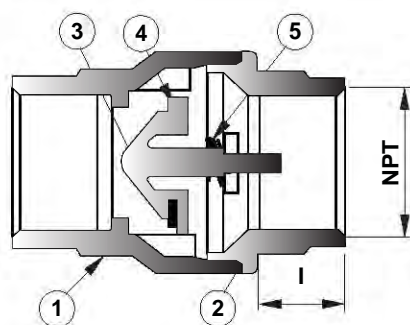
ITEM	DESCRIPTION	QTY
1	Cap (SS only)	1
2	Nut, Jam	1
3	Seat	1
4	Gasket	1
5	Disc	1
6	Spring	1
7	Ring, Retaining	1
8	Stem	1
9	O-Ring	1
10	Housing	1

—MODEL— **CDC-1**

Check Valve (Sizes 3/8" and 1/2")



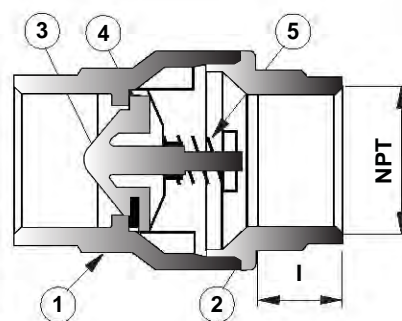
- NSF 61 Approved
- Meets low lead requirements
- Soft Seat for Bubble Tight Shutoff, Spring Loaded for Fast Seating Action
- Compact Design
- Low Cracking Pressure 1/2 psi
- Flow Profile Designed to Minimize Head Loss
- Perfect Seating both at High and Low Pressure, Wide Temperature Range: +10° to 210°F
- Polyetherimide Disc to ensure the Best Resistance for Corrosion and Abrasion
- Patented Disc Guide to Prevent Any Side Loading



Full Open Operation

Item	Description	Material
1	Body	Brass
2	End Connection	Brass
3	Disc	Polyetherimide
4	Seat	NBR
5	Spring	Stainless Steel

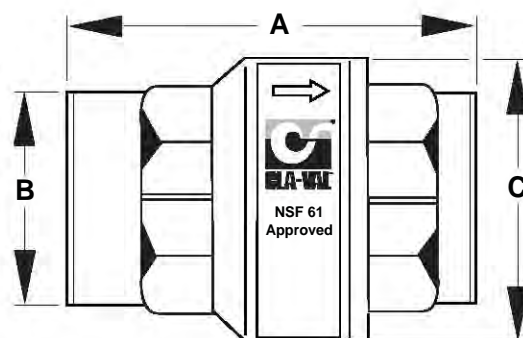
Available only in replacement assembly.



Tight Closing Operation

Dimensions

Size (NPT)	Stock Number	A	B	C	I	C _v	psi	Wt.
3/8"	9834501A	1.73	0.79	1.06	0.40	4.55	400	0.37
1/2"	9834502J	2.32	0.98	1.35	0.53	6.00	400	0.32





X43

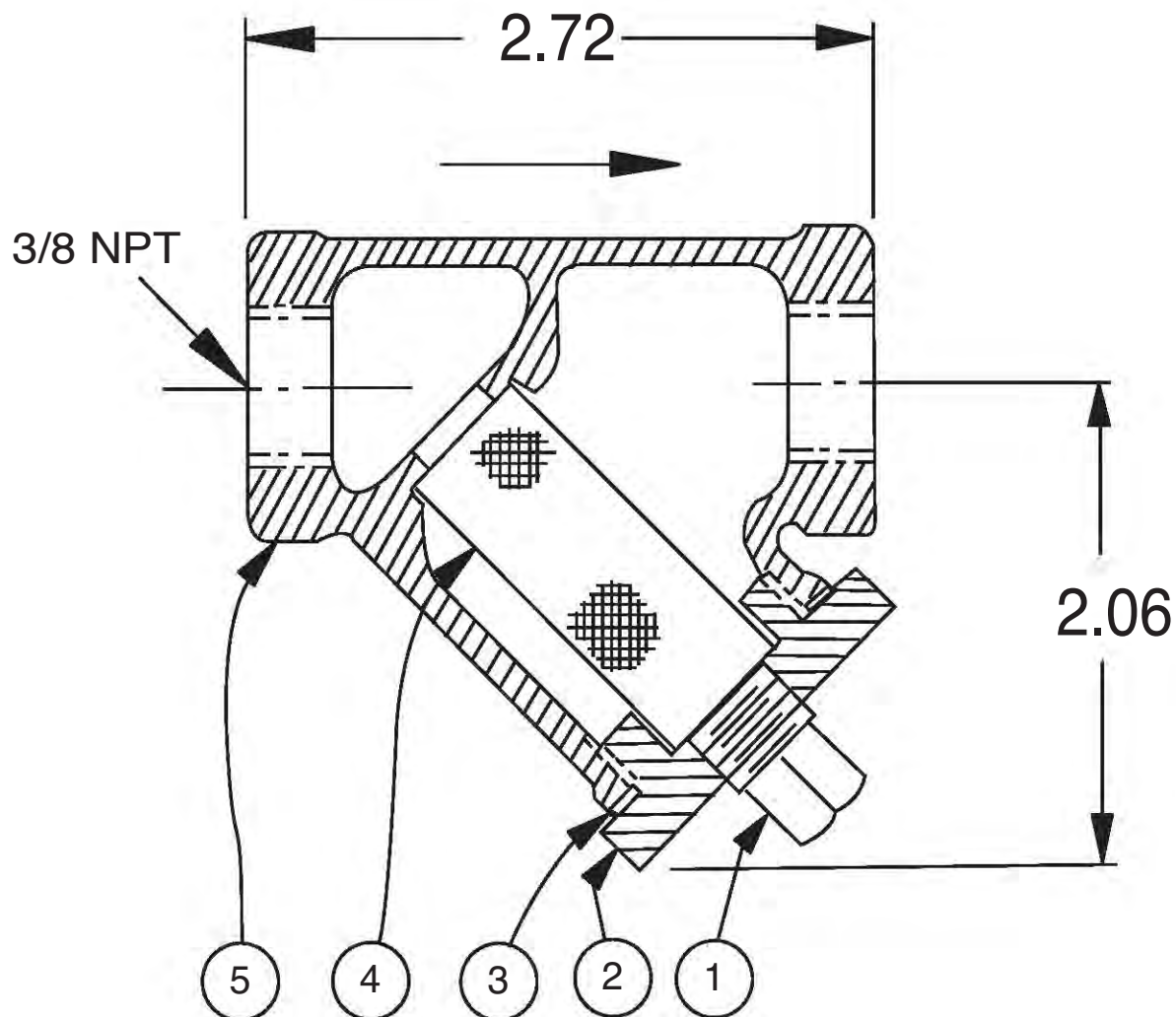
Strainer

ITEM	DESCRIPTION	MATERIAL
1	Pipe Plug	Steel
2	Strainer Plug	Brass
3	Gasket	Copper
4	Screen	SST
5	Body	Brass

No parts available. Replacement assembly only.

Standard 60 mesh pilot system strainer for fluid service.

Size	Stock Number
3/8 x 3/8	33450J





Cla-Val Product Identification

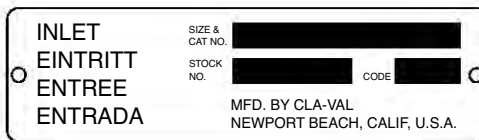
How to Order

Proper Identification

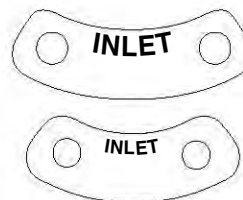
For ordering repair kits, replacement parts, or for inquiries concerning valve operation, it is important to properly identify Cla-Val products already in service by including all nameplate data with your inquiry. Pertinent product data includes valve function, size, material, pressure rating, end details, type of pilot controls used and control adjustment ranges.

Identification Plates

For product identification, cast-in body markings are supplemented by identification plates as illustrated on this page. The plates, depending on type and size of product, are mounted in the most practical position. **It is extremely important that these identification plates are not painted over, removed, or in any other way rendered illegible.**



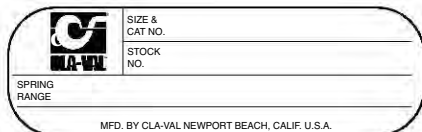
This brass plate appears on valves sized 2 1/2" and is located on the top of the inlet flange.



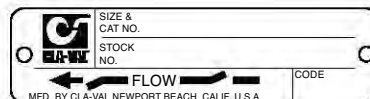
These two brass plates appear on 3/8", 1/2", and 3/4" size valves and are located on the valve cover.



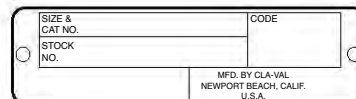
This brass plate appears on altitude valves only and is found on top of the outlet flange.



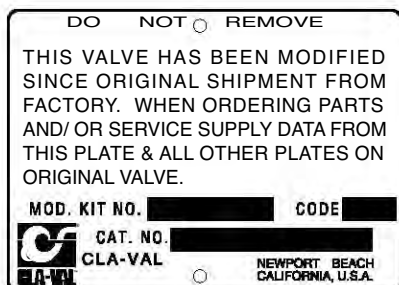
This tag is affixed to the cover of the pilot control valve. The adjustment range appears in the spring range section.



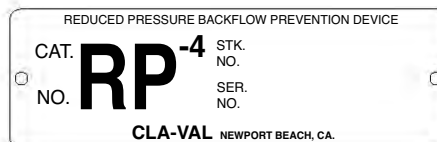
These two brass plates appear on threaded valves 1" through 3" size or flanged valves 1" through 2". It is located on only one side of the valve body.



This brass plate is used to identify pilot control valves. The adjustment range is stamped into the plate.



This aluminum plate is included in pilot system modification kits and is to be wired to the new pilot control system after installation.



This brass plate is used on our backflow prevention assemblies. It is located on the side of the Number Two check (2" through 10"). The serial number of the assembly is also stamped on the top of the inlet flange of the Number One check.



HOW TO ORDER

Because of the vast number of possible configurations and combinations available, many valves and controls are not shown in published product and price lists. For ordering information, price and availability on product that are not listed, please contact your local Cla-Val office or our factory office located at:

P. O. Box 1325
Newport Beach, California 92659-0325
(949) 722-4800
FAX (949) 548-5441

LIMITED WARRANTY

Automatic valves and controls as manufactured by Cla-Val are warranted for three years from date of shipment against manufacturing defects in material and workmanship that develop in the service for which they are designed, provided the products are installed and used in accordance with all applicable instructions and limitations issued by Cla-Val. Electronic components manufactured by Cla-Val are warranted for one year from the date of shipment.

We will repair or replace defective material, free of charge, that is returned to our factory, transportation charges prepaid, if upon inspection, the material is found to have been defective at time of original shipment. This warranty is expressly conditioned on the purchaser's providing written notification to Cla-Val immediate upon discovery of the defect.

Components used by Cla-Val but manufactured by others, are warranted only to the extent of that manufacturer's guarantee.

This warranty shall not apply if the product has been altered or repaired by others, Cla-Val shall make no allowance or credit for such repairs or alterations unless authorized in writing by Cla-Val.

SPECIFY WHEN ORDERING

- Model Number
- Globe or Angle Pattern
- Adjustment Range (As Applicable)
- Valve Size
- Threaded or Flanged
- Body and Trim Materials
- Optional Features
- Pressure Class

UNLESS OTHERWISE SPECIFIED

- Globe or angle pattern are the same price
- Ductile iron body and bronze trim are standard
- X46 Flow Clean Strainer or X43 "Y" Strainer are included
- CK2 Isolation Valves are included in price on 4" and larger valve sizes (6" and larger on 600 Series)

DISCLAIMER OF WARRANTIES AND LIMITATIONS OF LIABILITY

The foregoing warranty is exclusive and in lieu of all other warranties and representations, whether expressed, implied, oral or written, including but not limited to any implied warranties or merchantability or fitness for a particular purpose. All such other warranties and representations are hereby cancelled.

Cla-Val shall not be liable for any incidental or consequential loss, damage or expense arising directly or indirectly from the use of the product. Cla-Val shall not be liable for any damages or charges for labor or expense in making repairs or adjustments to the product. Cla-Val shall not be liable for any damages or charges sustained in the adaptation or use of its engineering data and services. No representative of Cla-Val may change any of the foregoing or assume any additional liability or responsibility in connection with the product. The liability of Cla-Val is limited to material replacements F.O.B. Newport Beach, California.

TERMS OF SALE

ACCEPTANCE OF ORDERS

All orders are subject to acceptance by our main office at Newport Beach, California.

CREDIT TERMS

Credit terms are net thirty (30) days from date of invoice.

PURCHASE ORDER FORMS

Orders submitted on customer's own purchase order forms will be accepted only with the express understanding that no statements, clauses, or conditions contained in said order form will be binding on the Seller if they in any way modify the Seller's own terms and conditions of sales.

PRODUCT CHANGES

The right is reserved to make changes in pattern, design or materials when deemed necessary, without prior notice.

PRICES

All prices are F.O.B. Newport Beach, California unless expressly stated otherwise on our acknowledgement of the order. Prices are subject to change without notice. The prices at which any order is accepted are subject to adjustment to the Seller's price in effect at the time of shipment. Prices do not include sales, excise, municipal, state or any other Government taxes. Minimum order charge \$100.00.

RESPONSIBILITY

We will not be responsible for delays resulting from strikes, accidents, negligence of carriers, or other causes beyond our control. Also, we will not be liable for any unauthorized product alterations or charges accruing there from.

RISK

All goods are shipped at the risk of the purchaser after they have been delivered by to the carrier. Claims for error, shortages, etc., must be made upon receipt of goods.

EXPORT SHIPMENTS

Export shipments are subject to an additional charge for export packing.

RETURNED GOODS

1. Customers must obtain written approval from Cla-Val prior to returning any material.
2. Cla-Val reserves the right to refuse the return of any products.
3. Products more than six (6) months old cannot be returned for credit.
4. Specially produced, non-standard models cannot be returned for credit.
5. Rubber goods such as diaphragms, discs, o-rings, etc., cannot be returned for credit, unless as part of an unopened vacuum sealed repair kit which is less than six months old.
6. Goods authorized for return are subject to a 35% (\$100 minimum) restocking charge and a service charge for inspection, reconditioning, replacement of rubber parts, retesting, repainting and repackaging as required.
7. Authorized returned goods must be packaged and shipped prepaid to Cla-Val, 1701 Placentia Avenue, Costa Mesa, California 92627.



E-Product I.D. (R-3/2011)

CLA-VAL

PO Box 1325 Newport Beach CA 92659-0325
Phone: 949-722-4800 • Fax: 949-548-5441

CLA-VAL CANADA

4687 Christie Drive
Beamsville, Ontario
Canada L0R 1B4
Phone: 905-563-4963
Fax: 905-563-4040

CLA-VAL EUROPE

Chemin des Mesanges 1
CH-1032 Romanel/
Lausanne, Switzerland
Phone: 41-21-643-15-55
Fax: 41-21-643-15-50

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www.cla-val.com

Represented By:



— MODEL — REPAIR KITS

Complete Replacement Diaphragm Assemblies for 100-01 and 100-20 Hytrol Main Valves

For: Hytrol Main Valves with Ductile Iron, Bronze Trim Materials—**125/150 Pressure Class Only.**
FACTORY ASSEMBLED

Includes: Stem, Disc Guide, Disc, Disc Retainer, Spacer Washers, Diaphragm, Diaphragm Washer and Stem Nut.

Valve Size		Diaphragm Assembly		Valve Size		Diaphragm Assembly	
		Stock Number				Stock Number	
		100-01	100-20			100-01	100-20
3/8"	(Also 81-01)	49097K	N/A	6"	40456G	33273E	
1/2" - 3/4"	(Also 81-01)	C2518D	N/A	8"	45276D	40456G	
1"		C2520K	N/A	10"	81752J	45276D	
1 1/4"-1 1/2"		C2522 F	N/A	12"	85533J	81752J	
2"		C2524B	N/A	14"	89067D	N/A	
2 1/2"		C2523D	N/A	16"	89068B	85533J	
3"		C2525J	C2524B	20"	N/A	89068B	
4"		33273E	C2525J	24"	N/A	89068B	

Repair Kits for 100-01/100-20 Hytrol Valves

For: Hytrol Main Valves—**125/150 Pressure Class Only.**

Includes: Diaphragm, Disc (or Disc Assembly) and spare Spacer Washers.

Buna-N® Standard Material				Viton (For KB Valves)			
Valve Size	Repair Kit Stock Number		Valve Size	Repair Kit Stock Number		Valve Size	Repair Kit Stock Number
	100-01	100-20		100-01	100-20		
3/8"	(Also 81-01)	9169801K	N/A	3/8"	(Also 81-01)	9169806J	N/A
1/2" - 3/4"	(Also 81-01)	9169802H	N/A	1/2" - 3/4"	(Also 81-01)	9169807G	N/A
1"		9169803F	N/A	1"		9169808E	N/A
1 1/4" - 1 1/2"		9169804D	N/A	1 1/4" - 1 1/2"		9169809C	N/A
2"		9169805A	N/A	2"		9169810A	N/A
2 1/2"		9169811J	N/A	2 1/2"		9169817F	N/A
3"		9169812G	9169805A	3"		9169818D	9169810A
4"		9169813E	9169812G	4"		9169819B	9169818D
6"		9169815K	9169813E	6"		9169820K	9169819B
8"		9817901D	9169815K	8"		9169834A	9169820K
10"		9817902B	9817901D				
12"		9817903K	9817902B				
14"		9817904H	N/A				
16"		9817905E	9817903K				
20"		N/A	9817905E				
24"		9817906C	9817905E				

When ordering, please give complete nameplate data of the valve and/or control being repaired.
MINIMUM ORDER CHARGE APPLIES.

Repair Kits for 100-02/100-21 Powertrol and 100-03/100-22 Powercheck Main Valves**For:** Powertrol and Powercheck Main Valves—**125/150 Pressure Class Only**

Includes: Diaphragm, Disc (or Disc Assembly) and O-rings and full set of spare Spacer Washers.

Valve Size	Kit Stock Number 100-02	Valve Size	Kit Stock Number	
			100-02 & 100-03	100-21 & 100-22
3/8"	9169901H	2 1/2"	9169910J	N/A
1/2" & 3/4"	9169902F	3"	9169911G	9169905J
1"	9169903D	4"	9169912E	9169911G
1 1/4" & 1 1/2"	9169904B	6"	9169913C	9169912E
2"	9169905J	8"	99116G	9169913C
		10"	9169939H	99116G
		12"	9169937B	9169939H

Repair Kits for 100-04/100-23 Hy-Check Main Valves

Larger Sizes: Consult Factory.

For: Hy-Check Main Valves—**125/150 Pressure Class Only**

Includes: Diaphragm, Disc and O-Rings and full set of spare Spacer Washers.

Valve Size	Kit Stock Number		Valve Size	Kit Stock Number	
	100-04	100-23		100-04	100-23
4"	20210901B	N/A	12"	20210905H	20210904J
6"	20210902A	20210901B	14"	20210906G	N/A
8"	20210903K	20210902A	16"	20210907F	20210905H
10"	20210904J	20210903K	20"	N/A	20210907F
			24"	N/A	20210907F

Repair Kits for Pilot Control Valves (In Standard Materials Only)

Larger Sizes: Consult Factory.

Includes: Diaphragm, Disc (or Disc Assembly), O-Rings, Gaskets or spare Screws as appropriate.

BUNA-N® (Standard Material)				VITON (For KB Controls)	
Pilot Control	Kit Stock Number	Pilot Control	Kit Stock Number	Pilot Control	Kit Stock Number
CDB	9170006C	CFM-7	1263901K	CDB-KB	9170012A
CDB-30	9170023H	CFM-7A	1263901K	CRA-KB	N/A
CDB-31	9170024F	CFM-9	12223E	CRD-KB (w/bucking spring)	9170008J
CDB-7	9170017K	CRA (w/bucking spring)	9170001D	CRL-KB	9170013J
CDH-2	18225D	CRD (w/bucking spring)	9170002B	CDHS-2BKB	9170010E
CDHS-2	44607A	CRD (no bucking spring)	9170003K	CDHS-2FKB	9170011C
CDHS-2B	9170004H	CRD-18	20275401K	CDHS-18KB (no bucking spring)	9170009G
CDHS-2F	9170005E	CRD-22	98923G	102C-KB	1726202D
CDHS-3C-A2	24657K	CRL (55F, 55L)	9170007A		
CDHS-8A	2666901A	CRL-4A	43413E		
CDHS-18	9170003K	CRL-5 (55B)	65755B		
CDS-4	9170014G	CRL-5A (55G)	20666E		
CDS-5	14200A	CRL-18	20309801C		
CDS-6	20119301A	CV	9170019F		
CDS-6A	20349401C	X105L (O-ring)	00951E	Buna-N®	
CFCM-M1	1222301C	102B-1	1502201F	CRD Disc Ret. (Solid)	C5256H
CFM-2	12223E	102C-2	1726201F	CRD Disc Ret. (Spring)	C5255K
		102C-3	1726201F		

Repair Assemblies (In Standard Materials Only)

Control	Description	Stock Number
CF1-C1	Pilot Assembly Only	89541H
CF1-CI	Complete Float Control less Ball and Rod	89016A
CFC2-C1	Disc, Distributor and Seals	2674701E
CSM 11-A2-2	Mechanical Parts Assembly	97544B
CSM 11-A2-2	Pilot Assembly Only	18053K
33A 1"	Complete Internal Assembly and Seal	2036030B
33A 2"	Complete Internal Assembly and Seal	2040830J

When ordering, please give complete nameplate data of the valve and/or control being repaired. **MINIMUM ORDER CHARGE APPLIES****CLA-VAL**P.O. Box 1325 • Newport Beach, CA 92659-0325 • Phone: 949-722-4800 • Fax: 949-548-5441 • E-mail: claval@cla-val.com • Website cla-val.com
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Air and Vacuum Release Valves for Waterworks, Irrigation and Landscape Systems

The exclusive AR Series, plastic and metal manufactured products offer outstanding features and advantages:

- Perfect sealing under very low system pressure.
- High Air flow capacity.
- Patented operation together with smart design.
- Simple, compact and reliable product.

The BERMAD AR Series air and vacuum release valves include four basic models:

- 1" Automatic pressure air release valve (Model 01-ARA), for the automatic release of entrapped air pockets from pressurized systems.
- 2" Kinetic air and vacuum release valve (Model 02-ARK), with large orifice, for the release of large quantities of air from filling pipelines and for admitting air into quick-draining pipelines to prevent vacuum damage.
- 2" Combination air and vacuum release valve (Model 02-ARC), in which the features of the two previous models are incorporated in one single valve body, for safe pipeline filling and draining and for releasing air pockets during system operation.
- 1/2" Vacuum breaker (Model ARV), prevents drip lines from clogging in tough topographic conditions and in sub-surface drip-irrigation system.



1/2"-ARV



01-ARA-P



01-ARA-I



02-ARC-P*
02-ARK-P*



02-ARC-I
02-ARK-I

Features

- Only one or two moving parts, depending on model
- Corrosion-resistant construction
- Pressure-balanced float, free of distortion or collapse
- Special drip-tight dynamic seal
- Exclusive kinetic design prevents floats from being blown shut
- Perfect sealing under system pressure as low as 0.1 bar, 1.5 psi

* Additional Hub to provide optional pressure source or pressure gauge connection is available for Plastic Model 02-ARC-P/02-ARK-P



Technical Data

Specifications

Sizes:

- 1" Automatic (Model 01-ARA)
- 2" Kinetic (Model 02-ARK)
- 2" Combination (Model 02-ARC)

End Connection:

- Threading BSP, NPT

Pressure Rating:

- Plastic body models: ISO PN 10
- Cast iron models: ISO PN 16; ANSI # 125

Operating Pressure Range:

- Plastic body: 0, 1-10 bar (1.5-150 psi)
- Iron body: 0, 1-16 bar (1.5-225 psi)

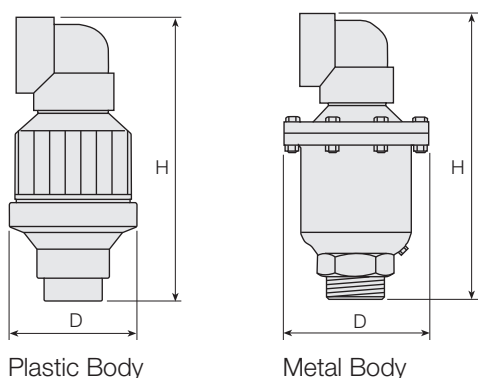
Temperature Range:

- Water, 4-50°C; 40-122°F

Materials:

- Body and cover: Plastic or polyester-coated cast iron
- Floats and kinetic shield: Plastic
- Automatic orifice: Stainless steel
- Seals: NBR and NR

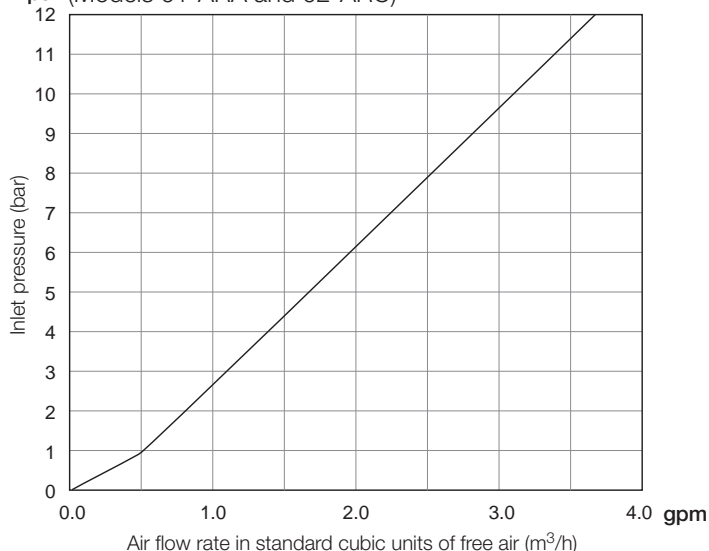
Dimensions and Weights



Performance Charts

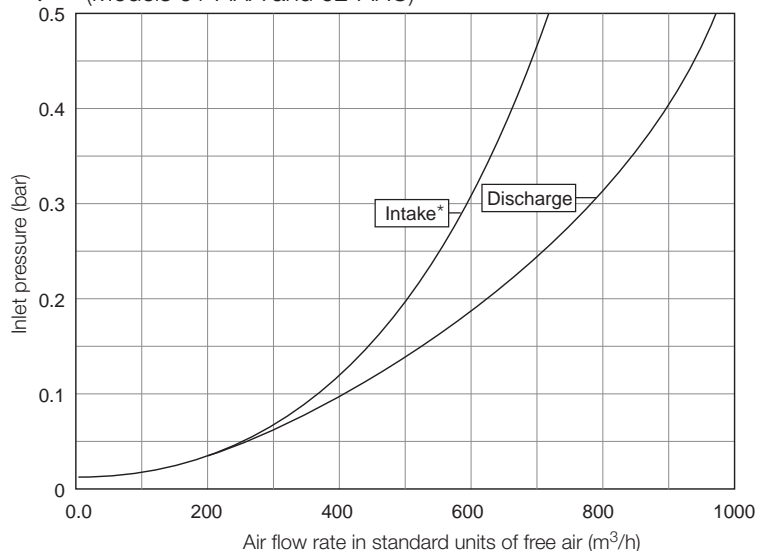
Automatic orifice for release of air under pressure

(Models 01-ARA and 02-ARC)



Kinetic large orifice for release of air under pressure

(Models 01-ARA and 02-ARC)



* Intake graph refers to negative pressure valves

Valve Model	Size	D (mm)	H (mm)	Weight (kg) (Plastic)	D (mm)	H (mm)	Weight (kg) (Metal)
Automatic (01-ARA)	1"	85	180	0.9	120	230	3.0
Kinetic (02-ARK)	2"	130	245	1.6	150	290	5.4
Combination (02-ARC)	2"	130	245	1.8	150	290	5.5



SECTION 10

SHIPPING SPECIFICATION

SPECIFICATION NUMBER: VS-13

SHIPPING OF STANDARD METAL ADSORBER SYSTEMS

1.0 INTRODUCTION

- 1.1 The following Calgon Carbon Corporation shipping, and handling instructions are designed to protect the mechanical integrity and the surface finish of the adsorber vessels and/or piping comprising an adsorption system. Proper handling procedures are required to ensure against damage to the new equipment.
- 1.2 The shipping and handling instructions outlined here are only recommendations and do not relieve any party from full responsibility for proper inspection, handling, shipping preparation, transporting, or unloading of the equipment. Also, the purchaser should be aware that failure to take the precautions outlined here may invalidate the equipment warranty.

2.0 GENERAL HANDLING AND LIFTING INSTRUCTIONS

- 2.1 Calgon Carbon Corporation equipment is designed with specific locations for lifting and will withstand normal handling procedures. The lifting lugs, shown on the general arrangement installation drawing, are generally located on top of the vessel. Fork tubes are located near the bottom of the equipment.

Refer to the project drawings is required before handling the equipment.

- 2.2 Normal precautions to follow to prevent equipment damage are as follows:
 - 2.2.1 Operators of hoist equipment must follow proper safety and rigging procedures at all times.
 - 2.2.2 Always lift -- **NEVER** roll or slide the vessels or piping.
 - 2.2.3 When moving equipment, do not drop or allow hard impact. Do not allow cables, hooks, or spanner bars to swing against the vessel.
 - 2.2.4 Never allow tools to strike or drop on equipment (especially inside or outside of vessels).
 - 2.2.5 All ladders used inside vessels should have ends protected. They should be wood construction; if not, ladders must have rubber protectors to prevent damaging the lining.
 - 2.2.6 Workmen entering a lined vessel must wear soft-soled shoes, free of grit. Workmen must follow plant and OSHA requirements for confined space entry.
 - 2.2.7 Always make lifting attachments to the lifting lugs when using chains or cables. Never lift from the nozzles.
 - 2.2.8 Never lift a vessel by using any fitting or appurtenance other than the lift lugs. When lift lugs are not provided as part of the equipment, nylon web rigging slings must be used by attachment directly to the corners of the structural frame. It is recommended that the nylon web be protected with rubber pads or sheets to prevent cutting or tearing across the corners.

3.0 PREPARATION FOR SHIPMENT

- 3.1 Calgon Carbon Corporation and their representatives are to take reasonable precautions when preparing equipment for shipment. Normally, a flat-bed truck will be used to transport the vessels, pipe rack and piping to the customer. Any hold-down location where a chain or strap contacts a painted surface must be protected with rubber sheeting, carpeting or other similar material.
- 3.2 Vessel loading will be the responsibility of the fabrication shop. Securing the load on the truck will be the responsibility of the truck driver. Painted surfaces must be protected from damage.
- 3.3 The pipe rack loading, if supplied, is the responsibility of the fabrication shop. The truck driver is to secure the rack to the truck bed. Points of contact are to be padded to protect the equipment.
- 3.4 All loose piping is to be loaded in such a manner as to avoid damage to painted surfaces. No chains are to be in direct contact with piping. Padding is to be used. Loading of loose piping will be the responsibility of the fabrication shop. The truck driver is to secure the piping to the truck bed.

4.0 SHIPPING REQUIREMENTS

- 4.1 Systems are typically shipped on one (1) truck. An additional truck may be required due to specific height or weight restrictions.
- 4.2 Once the vessels, pipe racks or loose piping are loaded onto a truck, they shall not be unloaded again until they reach their final destination.
- 4.3 No vessels, pipe racks or loose piping shall be shipped without a complete bill of lading which itemizes all parts. Also, no shipment shall be made without the completed packing list for crated parts which has been initialed by the person who packed and the person doing the checking.

5.0 INSPECTION UPON RECEIPT

- 5.1 The purchaser should arrange for an inspector or an authorized person at the jobsite to inspect and also supervise the off-loading of the system.
- 5.2 Check the bill of lading against the equipment received.
- 5.3 If damage has occurred during transit, it must be noted on the delivery receipt prior to signing acceptance. If damage has occurred, a claim should be filed promptly with the delivery carrier. If excessive damage is found:
 - Do not unpack or unload the equipment
 - Document the extent of the damage with photographs
 - Contact your Calgon Carbon representative
- 5.4 If no claim is filed, the purchaser accepts all further responsibility for damaged equipment.
- 5.5 If damage has occurred and is not repaired by Calgon Carbon Corporation prior to the equipment being put into service, the purchaser accepts all future responsibility for the effects of equipment failure resulting from such damage.

6.0 RECOMMENDED INSPECTION PROCEDURES

The following should be used as a guideline in making an inspection of the equipment prior to unloading.

- 6.1 The adsorber vessel exterior should be visually examined for damage. Any sign of impacting may result in cracked or flaking of the vessel interior lining. If this damage has occurred, it is required that the manway be opened and the interior lining be visually inspected.
- 6.2 Check the equipment for any signs of breakage, abrasion, shifting or rotation that may have resulted in damage to the paint on vessels, pipe rack, or loose piping.
- 6.3 Upon discovering minor or major damage, contact your Calgon Carbon representative to report your findings.

7.0 UNLOADING

- 7.1 Calgon Carbon Corporation specifically does not assume responsibility for the unloading of vessels, pipe racks or piping. Shipment will be considered complete when the equipment arrives at the jobsite and prior to removal of the equipment from the truck by the purchaser. The presence of Calgon Carbon Corporation representative(s) at the delivery or installation site does not relieve the purchaser of any of his responsibility for proper handling procedures.
- 7.2 All instructions shown in the Unloading/Foundations Section of the Calgon Carbon Corporation Operation and Maintenance Manual for this equipment shall be followed.
- 7.3 Vessel and pipe rack unloading shall be accomplished in such a manner as to avoid damage to finished surfaces. Adequate padding may be necessary around the lifting point.
- 7.4 The use of chains, slings, or a spreader bar is required for hoisting vessels and the pipe rack. The angle between the lifting point and the top of the equipment must always be 60° or greater. Workmen should keep control over the vessel with guidelines.

8.0 INSTALLATION

- 8.1 All instructions shown in Installation Section of the Calgon Carbon Corporation Operation and Maintenance Manual for this equipment shall be followed.

REVISIONS *

This specification has been revised as indicated below. The new pages added and/or the existing pages revised are attached as replacements for those previously issued.

REVISION	DATE	BY	PAGE	REMARKS
A	1-15-93	JMcM	All	Issued for Comment
B	5/19/93	JPM	All	Issued for Comment
C	9/1/93	JPM	2-3	Issued for Comment
D	10/12/93	JPM	3	Issued for Comment
E	11/13/07	JSR	All	
F	02/29/2008	RES	All	Modified to include vapor-phase equipment

ISSUED: JANUARY 15, 1993



SECTION 11

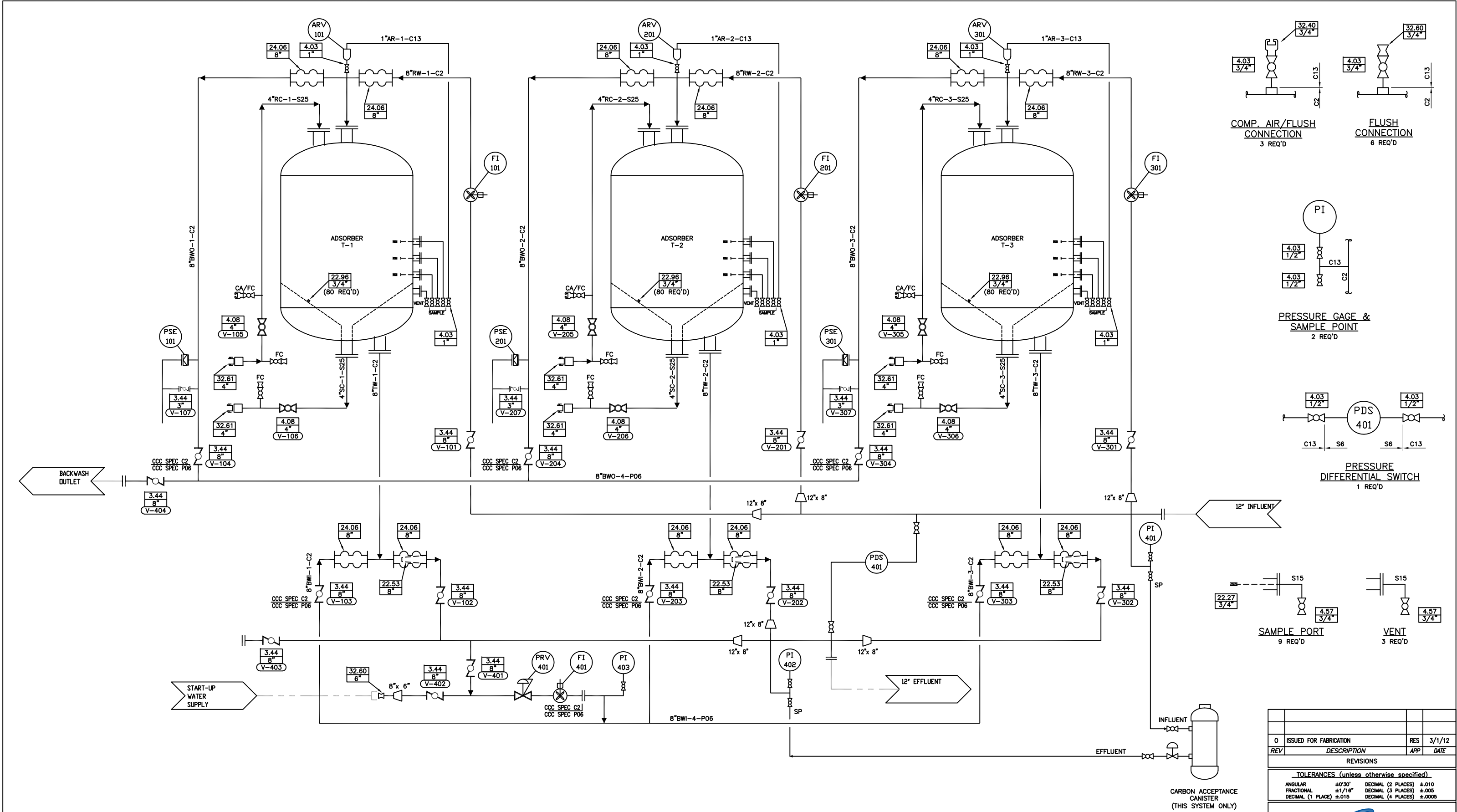
DRAWINGS

SECTION 11

DRAWING INDEX

DRAWING NUMBER	REVISION	TITLE
91126633	0	Carbon Adsorber System, (3) Model 10 Vessels, P&ID
91126634	0	Carbon Adsorber System, 10'Ø, 125 PSIG, Vessel Arrangement
91126635	0	Carbon Adsorber System, (3) Model 10 Vessels, General Arrangement; Sheet 1 thru 3

V:\2012\LM-12024.AQNY\Drawings\Process\91126633 Flow Diagram.dwg Apr 03, 2012 - 12:02pm



MEDIA
MEDIA: F300 AR QUANTITY PER VESSEL: 20,000 LBS. SERVICE: POTABLE

INSTRUMENTATION
PRESSURE GAGE - WIKA 233.34 PRESSURE DIFF. SWITCH - ASHCROFT 1131 FLOWMETER - SEAMETRIX TX-100 FLOW INDICATOR - SEAMETRIX FT415 PRESSURE RED. VALVE - CLA VAL 694-01 AIR RELEASE VALVE - BERMAD AR SERIES

DESIGN CONDITIONS
FLOW RATE - 2100 GPM (PARALLEL) INFLUENT PRESSURE - 100 PSIG MAX. INFLUENT TEMP. - 140°F MAX. BACKWASH RATE - 1000 GPM MAX.

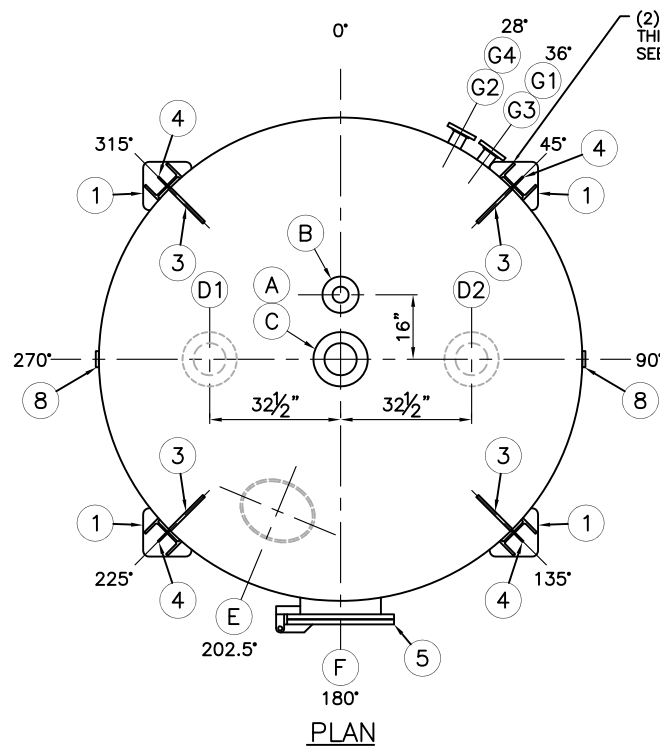
LEGEND
BW - BACKWASH WATER FC - FLUSH CONNECTION RC - REACT.(OR VIRGIN) CARBON RW - RAW WATER SC - SPENT CARBON SLURRY SP - SAMPLE PORT TW - TREATED WATER V - VENT

ADSORBERS
10'-0" O.D. x 12'-0" S.S. ASME 2:1 ELLIPTICAL TOP AND BOTTOM HEADS. CARBON STEEL CONSTRUCTION. ASME SECT. VIII, DIV. 1 W/ PLASITE 4110 LINING 125 PSIG @ 140°F DESIGN.

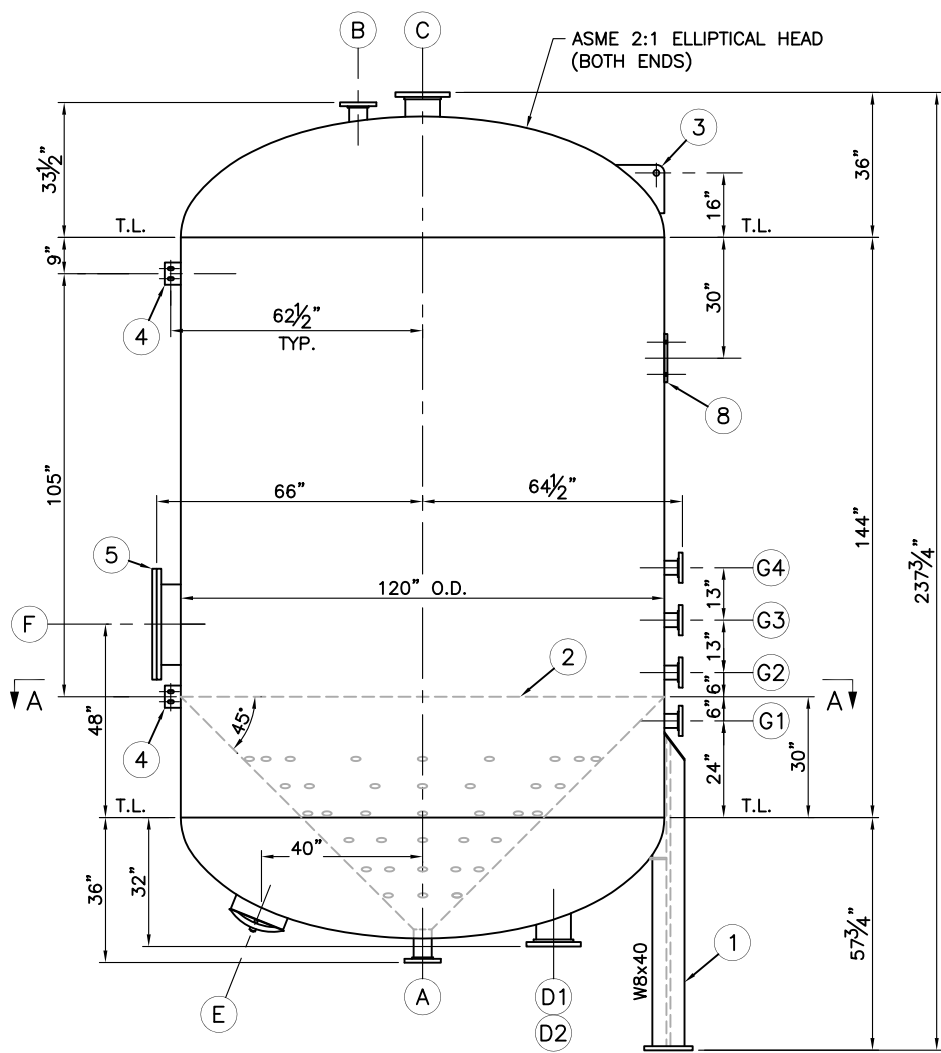
UTILITY REQUIREMENTS
AIR, CARBON TRANSFER - 100 SCFM @ 30 PSIG MIN. PLANT WATER - 100 GPM @ 30 PSIG MIN.

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CHECKER	RES	3/1/12
APPROVAL		
PROJECT No. LM-12024.AQNY		

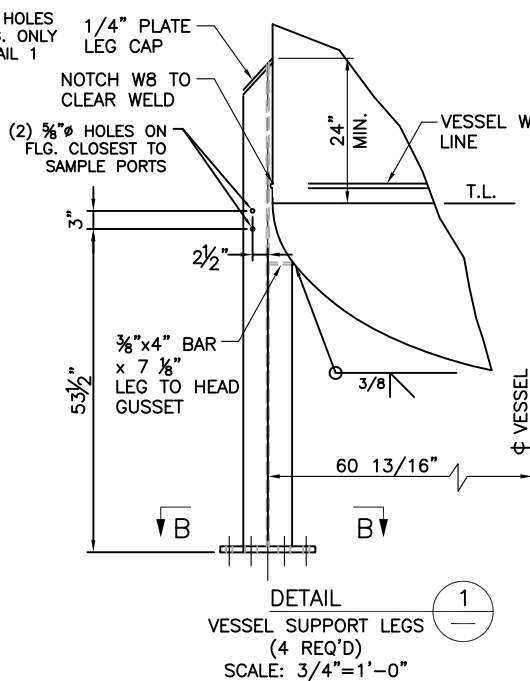
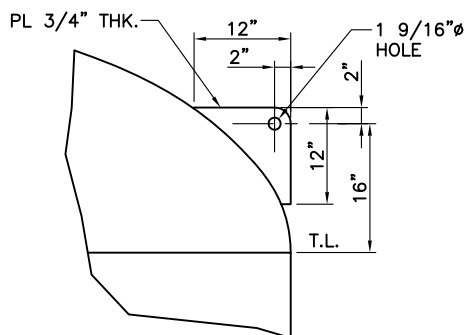
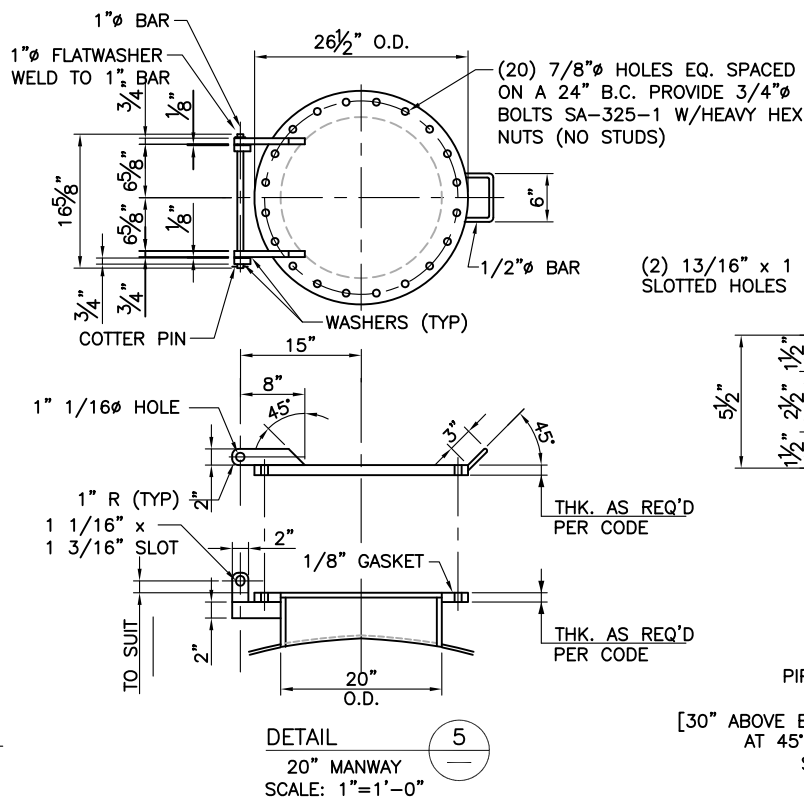
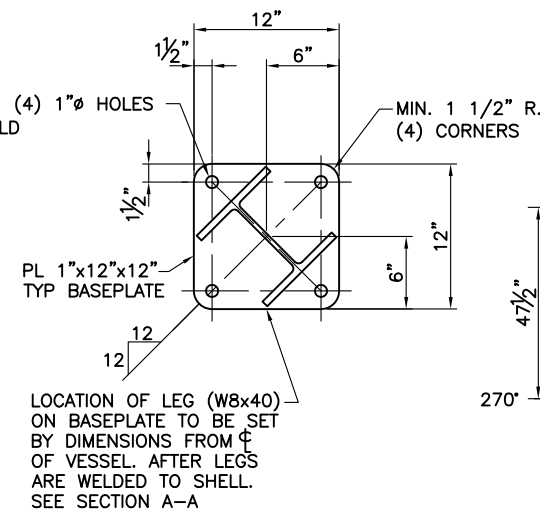
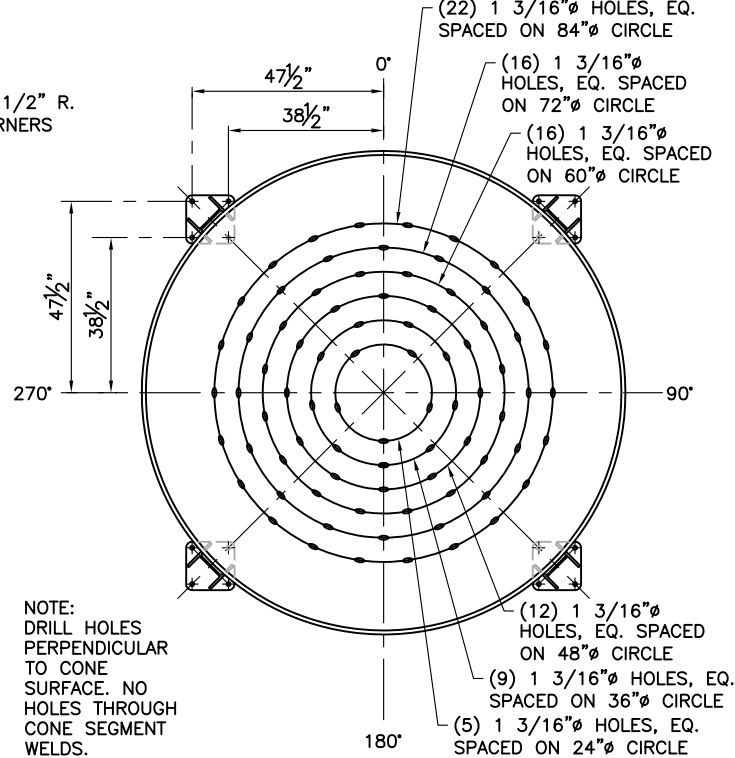
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TOLERANCES (unless otherwise specified)			
ANGULAR	±0°30'	DECIMAL (2 PLACES)	±.010
FRACTIONAL	±1/16"	DECIMAL (3 PLACES)	±.005
DECIMAL (1 PLACE)	±.015	DECIMAL (4 PLACES)	±.0005
CLIENT AGVIQ, LLC NASSAU COUNTY, NY			
TITLE CARBON ADSORBER SYSTEM (3) MODEL 10 VESSELS P & ID			
DWG. Size	D	SHEET No. 1 OF 1	SCALE NONE
DWG. No.	91126633	REV.	0



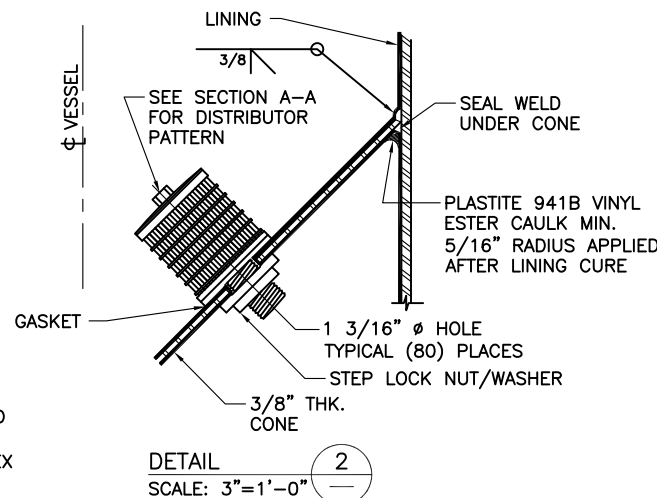
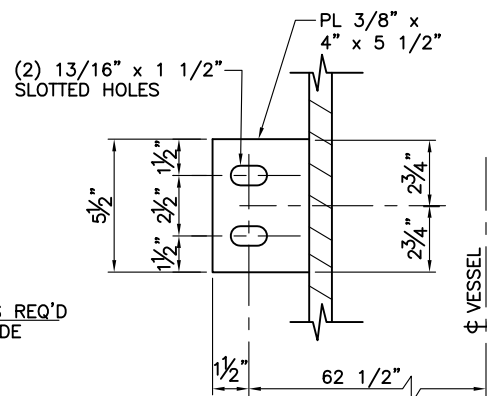
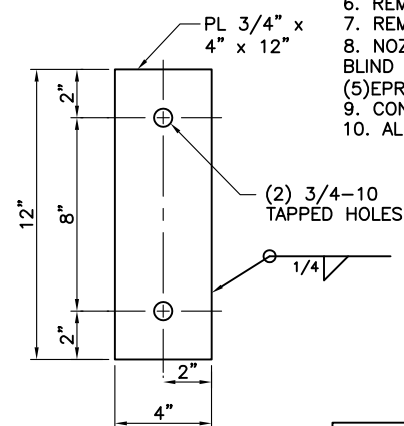
PLAN



ELEVATION

DETAIL
VESSEL SUPPORT LEGS
(4 REQ'D)
SCALE: 3/4"=1'-0"DETAIL
LIFTING LUGS
(4 REQ'D)
SCALE: 1"=1'-0"DETAIL
20" MANWAY
SCALE: 1"=1'-0"SECTION B-B
SCALE: 1 1/2"=1'-0"

SECTION A-A

DETAIL
SCALE: 3"=1'-0"DETAIL
PIPE SUPPORT CLIPS
(8 REQ'D)
[30" ABOVE BOT. T.L., 9" BELOW TOP T.L.]
AT 45°, 135°, 225° AND 315°
SCALE: 3"=1'-0"DETAIL
PIPE SUPPORT
(2 REQ'D)
SCALE: 3"=1'-0"

VESSEL DESCRIPTION		ADSORBER T-1, T-2 & T-3			
REFERENCES		VESSEL SPECIFICATION 7209A-VS1			
DESIGN CONDITIONS		125 PSIG @ 140° F			
OPERATING CONDITIONS		100 PSIG @ 100° F			
WALL THICKNESS		PER CODE REQUIREMENTS			
MATERIALS OF CONSTRUCTION	SHELL	SA-516-70			
	TOP HEAD	SA-516-70			
	BOT. HEAD	SA-516-70			
	NOZZLES	SA-106 GR. B			
	FLANGES	SA-105 (O.N.O.)			
	LINING ABOVE CONE	PLASITE 4110 35-45 MIL NOMINAL DFT PIN HOLE FREE FOR IMMERSION SERVICE			
	LINING BELOW CONE	PLASITE 4110 10-15 MIL NOMINAL DFT			
	SEALANT	PLASITE 941B VINYLESTER CAULK			
	SUPPORTS	A-992			
BOLTING	SA-325-1 WITH HEAVY HEX NUT - SEE NOTE 4				
GASKETS	1/8" EPR (45-55 DUROMETER) [1/4"TK. ELLIP]				
TYPE CONSTRUCTION	FUSION WELDED				
CORROS. ALLOW.	NONE				
CODE	ASME SECTION VIII, DIVISION 1, 2001 ED., 2002 ADDENDUM				
INSPECTION	BY CALGON & CODE AGENCY				
STAMPING	ASME "U", NBR				
TESTING	HYDROSTATIC PER CODE				
STRESS RELIEF	PER CODE				
RADIOGRAPH	PER CODE AND CALGON CALCULATIONS				
NAMEPLATE	ASME				
STENCILS	LINED TANK: DO NOT WELD OR BURN				
SEISMIC LOAD	ZONE 4 I=1.0				
INSULATION	NONE - SEE NOTE 9				
SURFACE PREP	BRUSH BLAST PER SSPC-SPC7				
PAINTING	5-7 MILS DFT, CARBOLINE EPOXY 890 COLOR: #0908 (O'BRIEN SAND)				
LOCATION					
CAPACITIES	FULL	9,020 GAL.			
	OPERATING	9,020 GAL.	AT 100 % FILL		
	MEDIA	20,000 LBS.	(750 CU.FT.)		
PRODUCT S. G.		GR. 1.2			
WEIGHTS	EMPTY	16,500	LBS.		
	FULL H ₂ O	91,800	LBS.		
	FULL PRODUCT	36,500	LBS.		
	OPERATING	106,800	LBS.		
NOZZLE SCHEDULE					
MARK	REQ'D	SIZE	DRILLING	FACING	DESCRIPTION
G	4	2"	150#	F.F.	SAMPLE POINT & VENT- SEE NOTE 8
F	1	20"		F.F.	MANWAY (BLIND GSKT.)
E	1	14"x18"	ELLIP.	F.F.	MANWAY WITH 1/4" TK. GASKET
D	2	8"	150#	F.F.	EFFLUENT - SEE NOTE 8
C	1	8"	150#	F.F.	INFLUENT
B	1	4"	150#	F.F.	CARBON INLET/VENT
A	1	4"	150#	F.F.	CARBON OUTLET SCH. 160 PIPE

NOTES:

- ALL INTERIOR WELDS & EDGES TO BE GROUND TO 1/8" MIN.
- ALL NOZZLES MUST BE FLUSH ON INSIDE OF SHELL, U.O.N
- DETAIL 2, SECTION A-A, FIELD INSTALLED.
- ALL NUTS & BOLTS TO BE ZINC PLATED.
- 20" MANWAY FLG. TO BE SECURED WITH (2) BOLTS. REMAINDER OF BOLTS & NUTS TO BE PACKAGED AND SHIPPED IN THE CRATE.
- REMOVE ALL WATER & DIRT AFTER HYDRO.
- REMOVE ALL WELD SPATTER.
- NOZZ. G2, G3, G4 & (1) NOZZ. D TO INCLUDE ASTM A105 150 LB. BLIND FLANGE, BOLTS, NUTS AND BLIND FLANGE GASKET INSTALLED, TOTAL (5)EPR BLIND GASKETS REQ'D INCLUDING MANWAY GASKET
- CONTACT CCC FOR HEAT TRACE REQUIREMENTS.
- ALL FLANGE BOLT HOLES TO STRADDLE CENTERLINES.

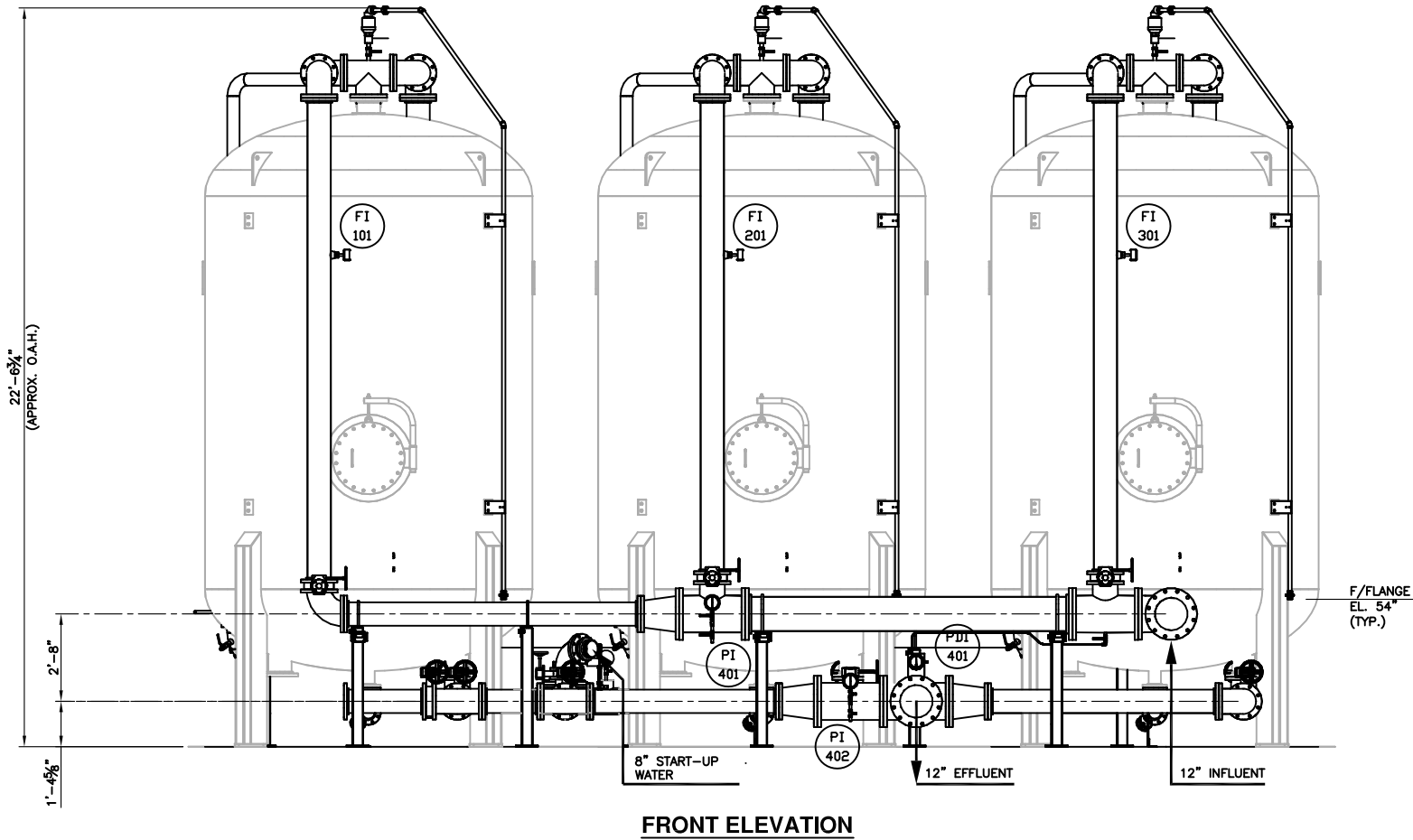
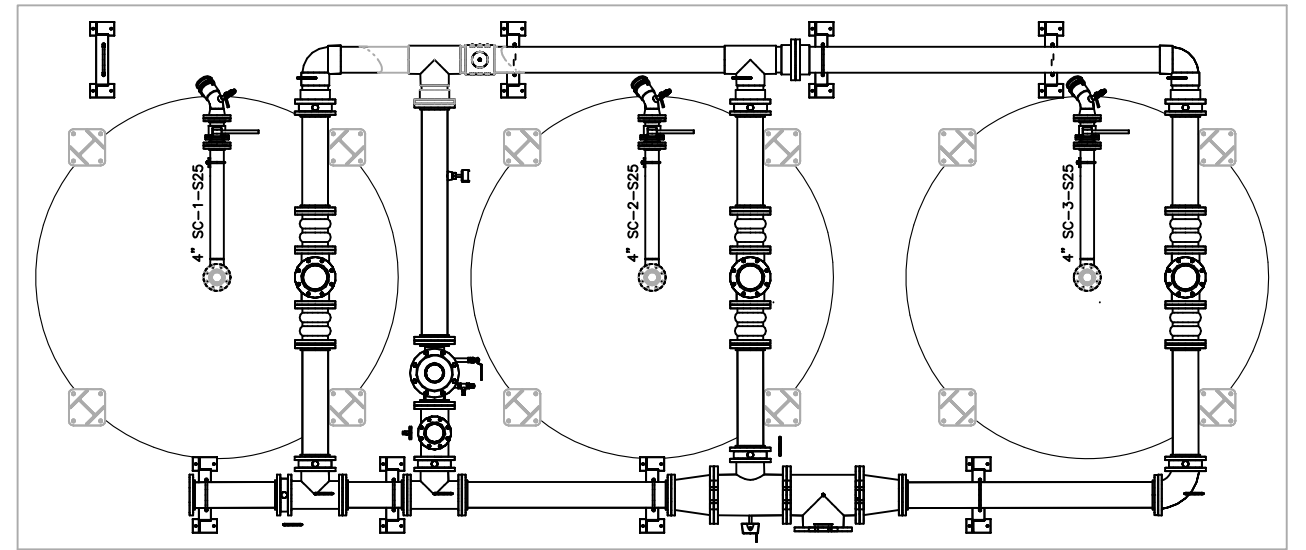
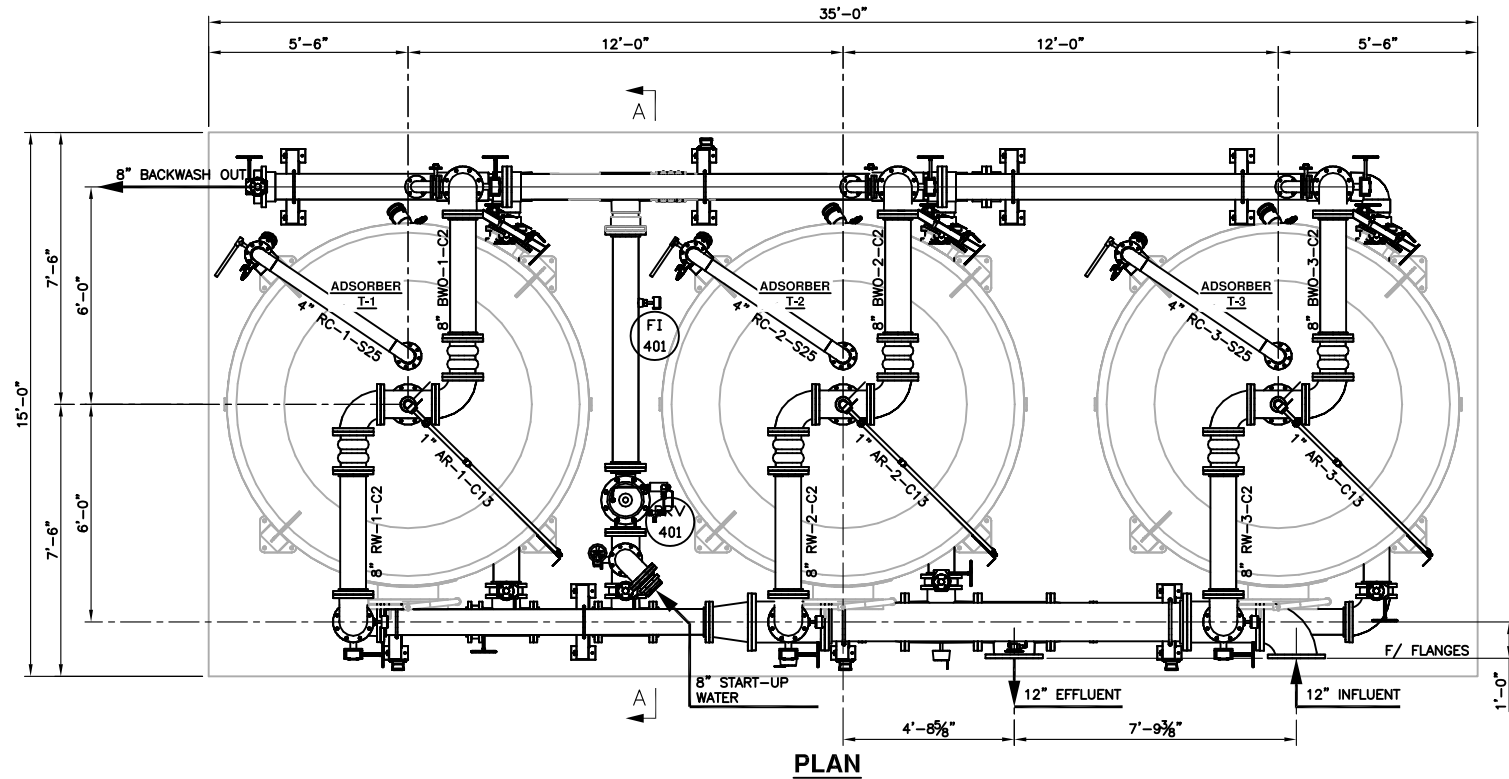
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PROJECT No.	LM-12024.AQNY

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FRACTIONAL	±1/16"	DECIMAL (3 PLACES)	±0.005
DECIMAL (1 PLACE)	±0.015	DECIMAL (4 PLACES)	±0.0005
CLIENT			
AGVIQ, LLC NASSAU COUNTY, NY			
TITLE			
CARBON ADSORBER SYSTEM 10' DIA., 125 PSIG VESSEL ARRANGEMENT			
DWG. No.	D	SHEET No.	1 OF 1
DWG. No.	91126634	SCALE	NONE
REV.	0		

CalgonCarbon

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NOTES:
1. ALL PROCESS PIPING CONNECTIONS
TO BE CLASS 150.

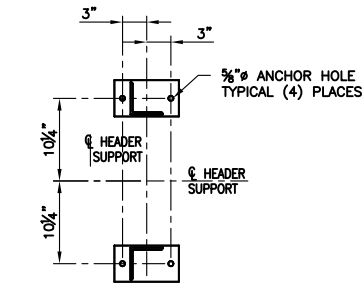
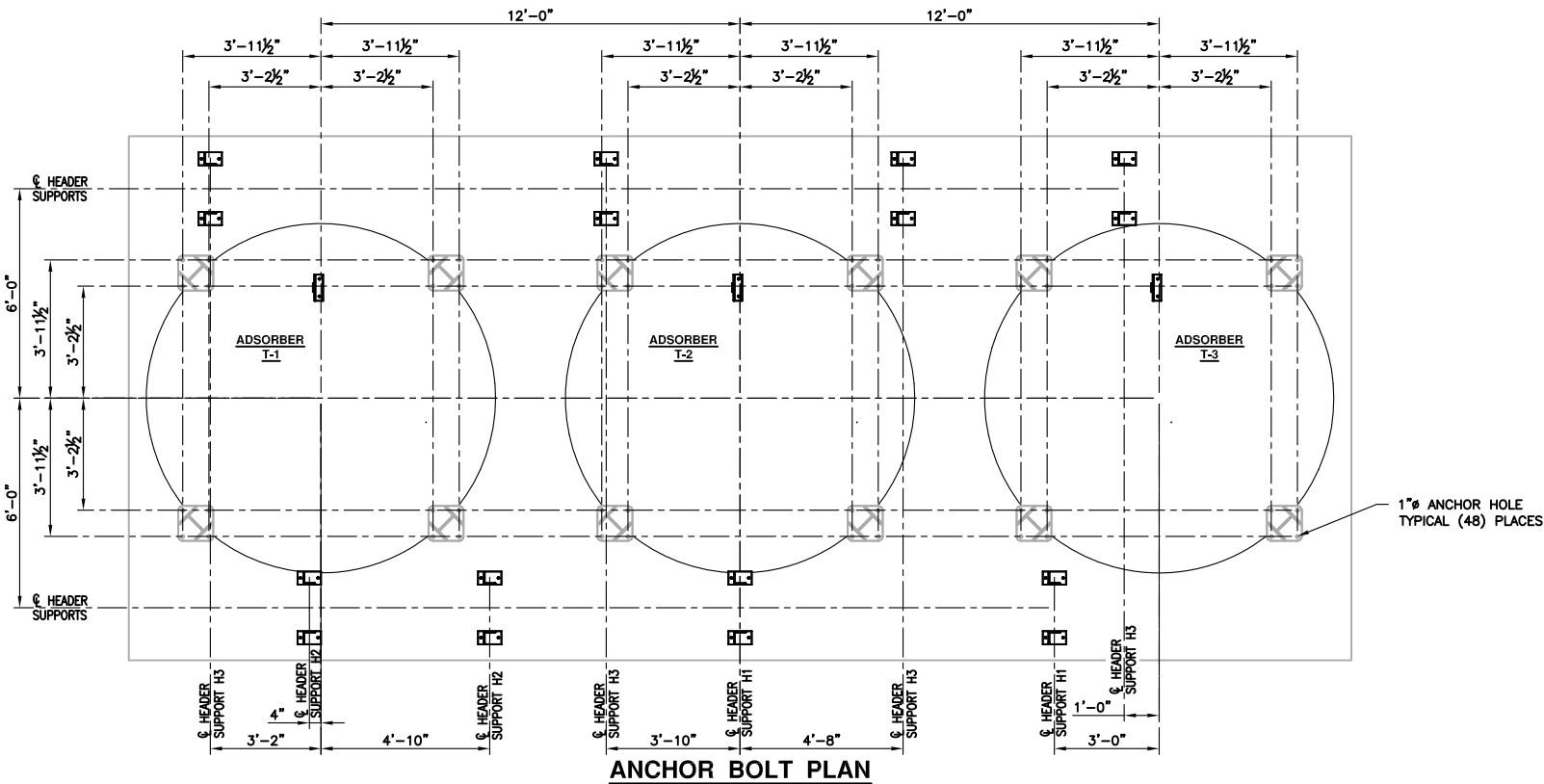
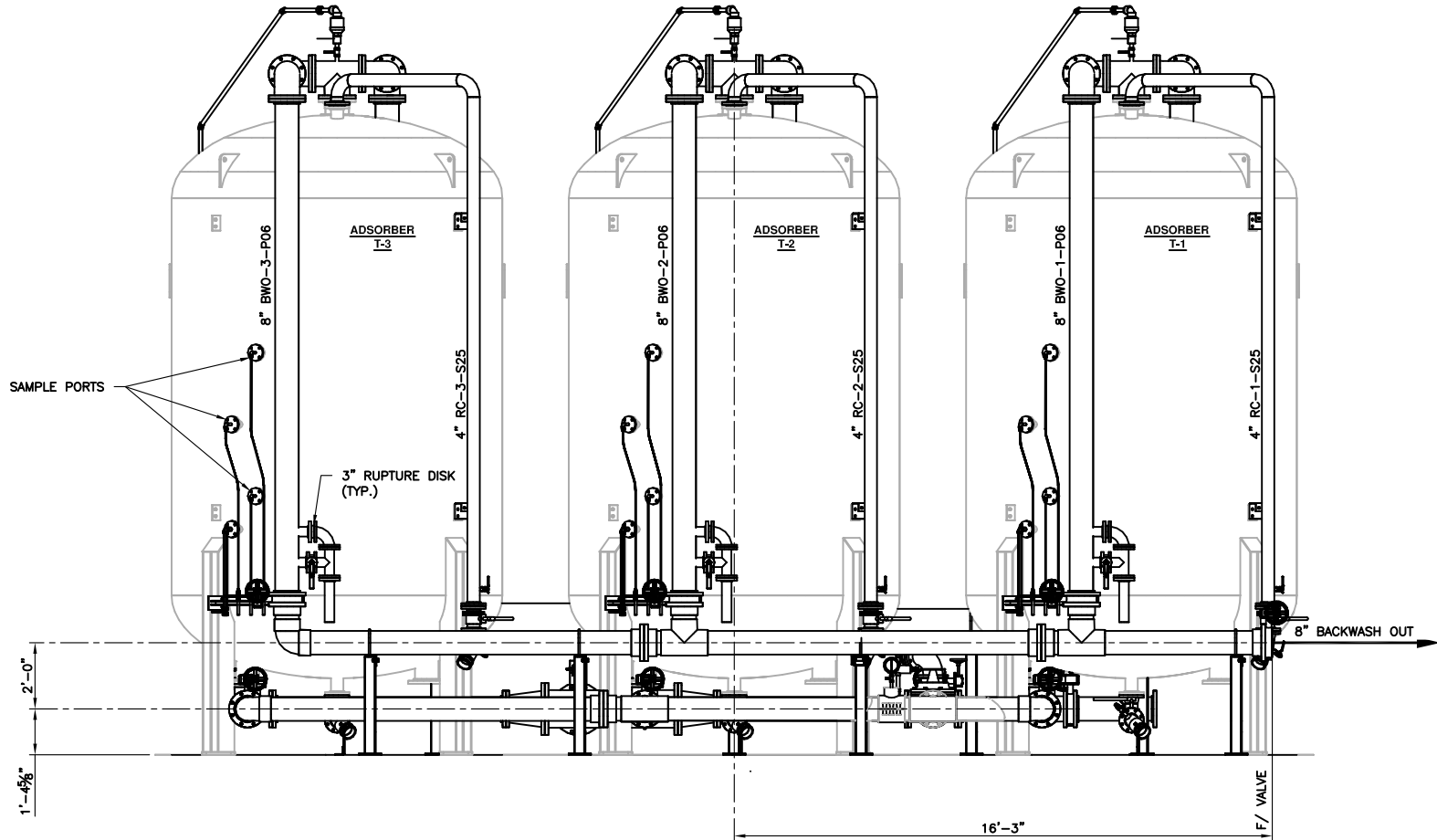
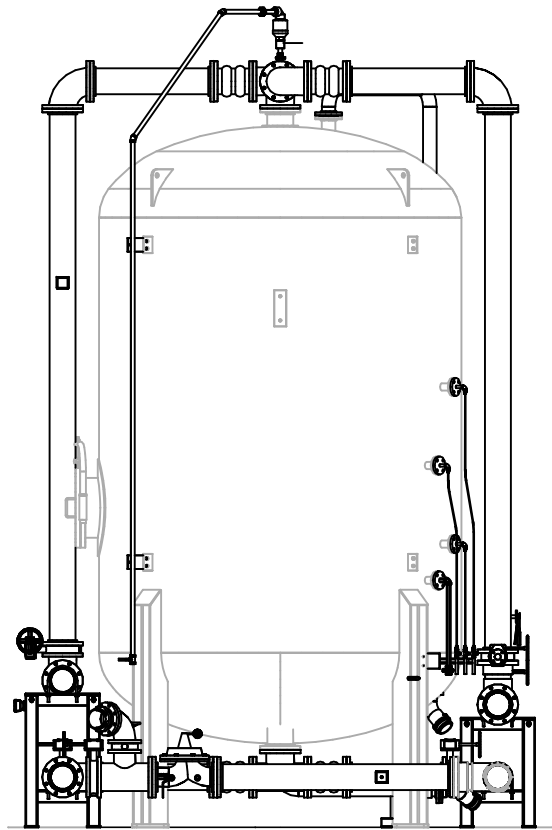
ESTIMATED WEIGHTS
VESSEL (EMPTY): 16,500 LBS.
VESSEL (OPERATING): 106,800 LBS.

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APPROVAL	
PROJECT No.	LM-12024.AQNY

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FRACTIONAL	±1/16"	DECIMAL (3 PLACES)	±0.005
DECIMAL (1 PLACE)	±0.015	DECIMAL (4 PLACES)	±0.0005
CLIENT			
AGVIQ, LLC NASSAU COUNTY, NY			
TITLE			
CARBON ADSORBER SYSTEM (3) MODEL 10 VESSELS GENERAL ARRANGEMENT			
DWG. Size	D	SHEET No.	1 OF 3
DWG. No.	91126635	SCALE	NONE
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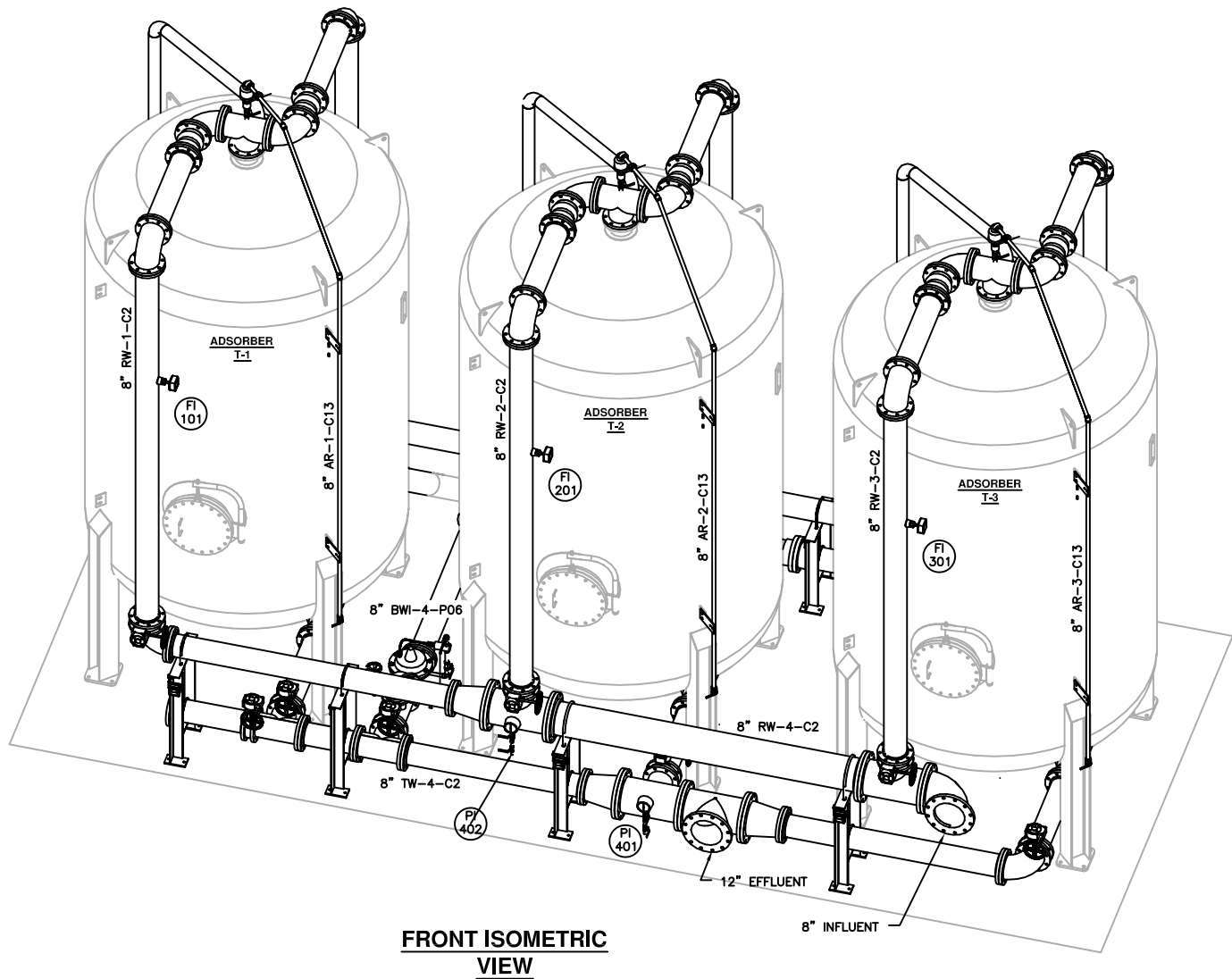
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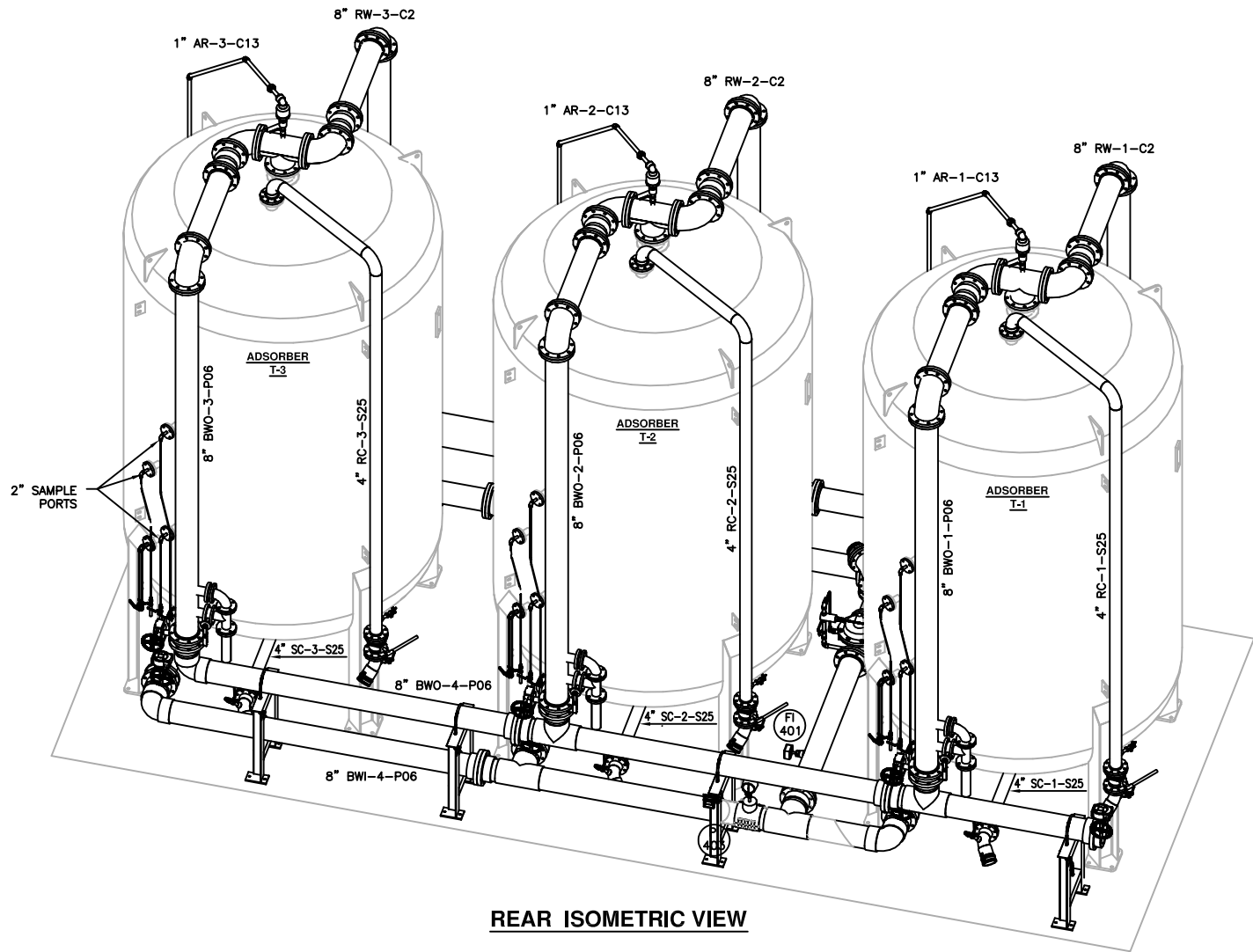
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CHECKER	RES	3/1/12
APPROVAL		
PROJECT No.	LM-12024.AQNY	

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REVISIONS			
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FRACTIONAL	±1/16"	DECIMAL (3 PLACES)	±.005
DECIMAL (1 PLACE)	±.015	DECIMAL (4 PLACES)	±.0005
CalgonCarbon			
CLIENT AGVIQ, LLC NASSAU COUNTY, NY			
TITLE CARBON ADSORBER SYSTEM (3) MODEL 10 VESSELS GENERAL ARRANGEMENT			
DWG. Size	D	SHEET No.	2 OF 3
DWG. No.	91126635	SCALE	NONE
REV.	0		

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FRONT ISOMETRIC
VIEW



REAR ISOMETRIC VIEW

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CHECKER	RES	3/1/12
APPROVAL		
PROJECT No.	LM-12024.AQNY	

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REV	DESCRIPTION	APP	DATE
REVISIONS			
TOLERANCES (unless otherwise specified)			
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FRACTIONAL	±1/16"	DECIMAL (3 PLACES)	±.005
DECIMAL (1 PLACE)	±.015	DECIMAL (4 PLACES)	±.0005
CalgonCarbon			
CLIENT AGVIQ, LLC NASSAU COUNTY, NY			
TITLE CARBON ADSORBER SYSTEM (3) MODEL 10 VESSELS GENERAL ARRANGEMENT			
DWG. Size	D	SHEET No. 3 OF 3	SCALE NONE
DWG. No.	91126635		REV. 0